

Energy
A Continuing
Bibliography
with Indexes

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IAA (A-10000 Series)

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ENERGY

A Continuing Bibliography

With Indexes

Issue 31

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from July 1 through September 30, 1981 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

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INTRODUCTION

This issue of *Energy A Continuing Bibliography with Indexes* (NASA SP-7043(31)) lists 1111 reports, journal articles, and other documents announced between July 1, 1981 and September 30, 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

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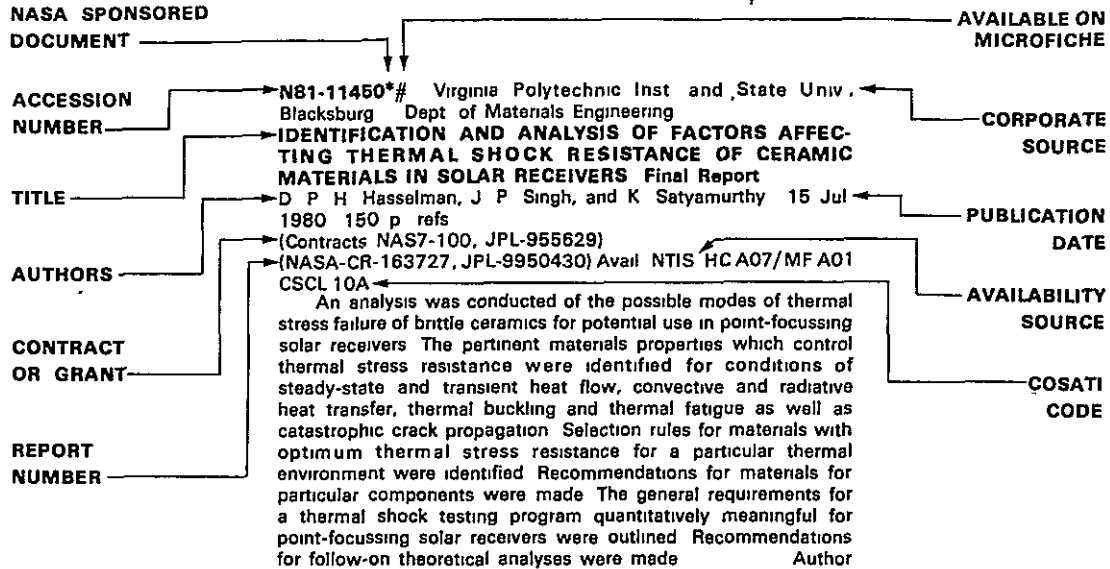
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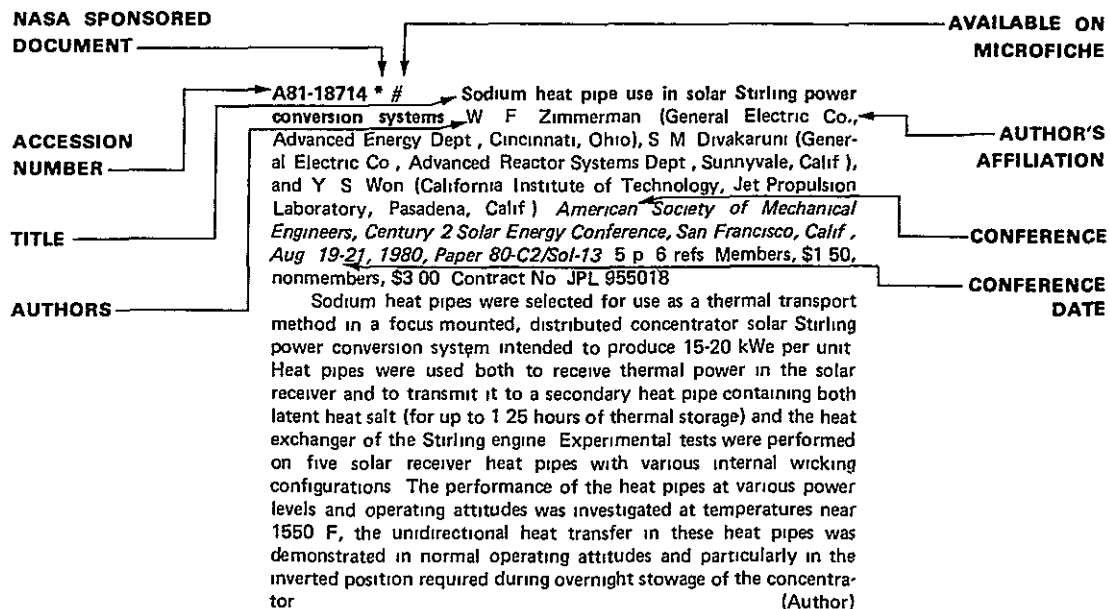
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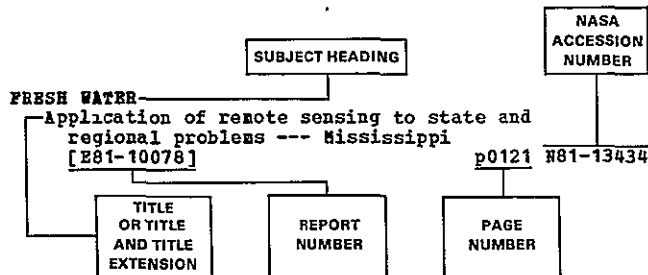
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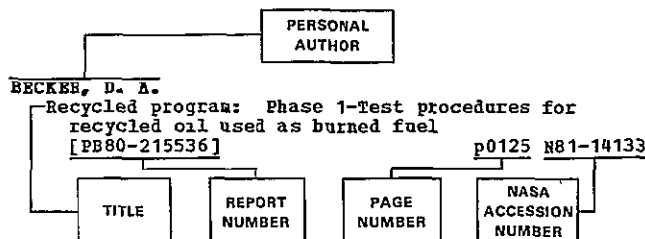
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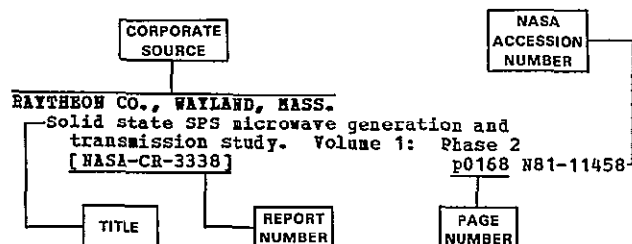
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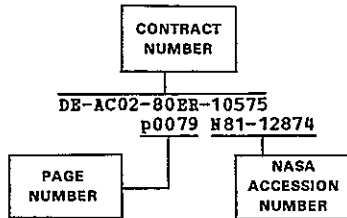
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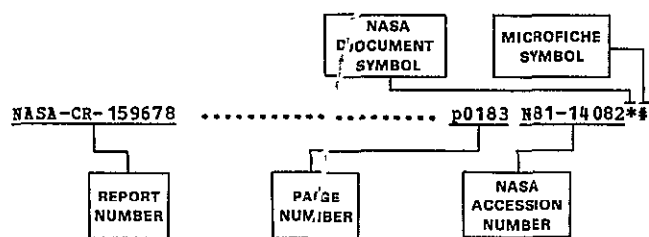
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OCTOBER 1981

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ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation and environmental impacts of energy systems

A81-30469 Air pollution constraints on increased coal use by industry - An international perspective E S Rubin (Carnegie-Mellon University, Pittsburgh, Pa.) *Air Pollution Control Association, Journal*, vol 31, Apr 1981, p 349-360 50 refs

Technological options for decreasing air pollutant emissions from coal-fired industrial boilers are reviewed in detail. Data compiled from current technical literature are analyzed to determine energy penalties, solid or liquid waste impacts, and economic costs associated with particulate and SO₂ removal systems for different boiler sizes, coal types, and air pollutant emission levels. It is argued that national decisions regarding acceptable tradeoffs among these factors will determine the nature of future emission control constraints on the increased use of coal. It is concluded that the development of compatible industrial and environmental policies depends on extensive consultation between industrial and regulatory policy makers. O C

A81-30472 Remote SO₂ mass flux measurements using COSPEC R M Hoff (Department of the Environment, Atmospheric Dispersion Div., Downsview, Ontario, Canada) and M M Millan (Barringer Research, Ltd., Weston, Ontario, Canada) *Air Pollution Control Association, Journal*, vol 31, Apr 1981, p 381-384 13 refs

During the intensive Nanticoke Environmental Field Study of May/June 1978, three Barringer Correlation Spectrometers (COSPEC) were employed to obtain remote sensing estimates of sulfur dioxide emissions from a coal fired hydroelectric generating station. The results from about 100 half-hourly sampling periods show that the COSPEC derived estimate is within 7% of those computed by the utility. The sources of the variance in the COSPEC flux estimate are examined and sampling recommendations regarding the use of COSPEC for this purpose are made. (Author)

A81-30474 A comparative assessment of flue gas treatment processes I - Status and design basis C E Jahnig and H Shaw (Exxon Technology Feasibility Center, Linden, N.J.) *Air Pollution Control Association, Journal*, vol 31, Apr 1981, p 421-428 20 refs U.S. Environmental Protection Agency Contract No. 68-02-2146

The developmental status and design specifications of 14 flue gas treatment processes are compared with attention to the effectiveness of these processes in controlling particulate matter, NO(x), trace inorganics, and polyorganic matter. The processes are divided into those operating once through and those with regeneration. Prospects for by-product credits for gypsum, sulphur, sulphuric acid, and ammonium sulfate are considered as well as the potential environmental impact of the residual emissions of the pollutants NO(x). Control processes that are compatible with scrubbers or dry processes are also analyzed. L S

A81-30652 Noveler - A company specializing in energy redeployment (Une société spécialisée dans le redéploiement énergétique - Noveler) J Dillard and J-P Hauet (Compagnie Générale d'Electricité, Paris, France) *Revue de l'Energie*, vol 32, Mar-Apr

1981, p 141-148 In French

The activities of the French national company Noveler, which operates to implement the energy plans of the Compagnie Générale d'Electricité, are discussed. Noveler has developed programs for energy conservation in new and existing dwellings, and in industry, making use of passive and active solar energy systems, insulation, microprocessor heating control, conservation of primary energy, and coal utilization. Activities in the field of renewable energy development include the investigation of production technologies and applications for photovoltaic solar energy conversion and the utilization of biomass. Programs of research on electric battery couples and the production of electrolytic hydrogen are also under way. A L W

A81-31282 # Transient NO(x) emission of direct injection type diesel engine K Yoshizumi, S Fukuoka, and T Ishiguro (Tokyo Metropolitan Research Institute for Environmental Protection, Tokyo, Japan) *Japan Society of Air Pollution, Journal*, vol 15, no 9, 1980, p 374-379 6 refs In Japanese, with abstract in English

A direct injection diesel engine of displacement 3.6 liters is operated on an engine dynamometer with flywheels. Exhaust gases are measured to simulate the transient NO(x) emission in terms of the emission under steady-state conditions. While NO(x) emission characteristics are investigated under steady-state conditions, the NO(x) concentration during acceleration is compared with that under steady states on the basis of fuel consumption. It is found that both the transient and steady concentrations nearly coincide during the acceleration of 1.53 km/hr/sec starting at 21.3 km/hr with the third gear, position. Through the acceleration of 3.24 km/hr/sec, however, the steady-state concentration showed a 10% higher value than the transient. The frequency matrix distributions of engine load under 10 kinds of actual traffic patterns are obtained as a function of engine revolution and torque. NO(x) emissions are calculated by combining these distributions with steady-state emissions. The estimated NO(x) emissions, which have values slightly lower than the transient emissions, show a good correlation with the transient emissions. Classification of engine load is found to be a principal factor. (Author)

A81-31283 Athena - A policy for economic assessment of space technology offshoots (Athéna - Une politique de valorisation des retombées technologiques spatiales) D G Compard (Société Nationale Industrielle Aérospatiale, Division Systèmes Balistiques et Spatiaux, Les Mureaux, Yvelines, France) *L'Aéronautique et l'Astronautique*, no 86, 1981, p 37-51 In French

A comprehensive review is presented of the Athena aerospace technology evaluation program. The range of state of the art technologies covered in this assessment of economic value extends to photovoltaic energy conversion, flywheel energy storage, satellite inertial stabilization devices, composite high pressure vessels, carbon carbon high temperature composites, ballistic missile systems, medical instruments, plasma arc generators and their metallurgical applications, magnetic bearings and security systems. O C

A81-31423 Perspectives on long-term energy supply - Problems and prospects (Perspektiven der langfristigen Energieversorgung - Aufgaben und Möglichkeiten) K W Edwin (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany) *Energiewirtschaftliche Tagesfragen*, vol 31, Apr 1981, p 322-329 12 refs In German

An attempt is made to determine the essential influences on the relationship between the development of human society and the energy supply. A brief review shows energy consumption to increase with increasing population and technological sophistication. The high

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consumption of primary energy, especially oil, and the high reliance on imported oil by the industrialized countries is graphically shown. From the predictions of possible energy consumption until the year 2150, it is found that only nuclear energy and regenerative energy sources will be able to satisfy the increased demand. Nuclear energy is also shown to be of primary importance for satisfying the energy needs of Germany, as other alternative sources are calculated as being able to meet only 5.63% of primary energy needs in the year 2000. D K

A81-31509 The representation of variable hydro potential in long-range electricity planning models. B. R. Smith (Wellington, Victoria University, Wellington, New Zealand). *Energy* (UK), vol. 6, Apr. 1981, p. 323-331. 8 refs.

The long range planning of electricity supply in countries for which hydro power constitutes a sizeable proportion of total capacity should take into account the effects of variable hydro inflow. Fluctuations occur in the water intake to storage lakes from year to year, reserve generating capacity is required to ensure that demand can still be met in years of low water intake. The least cost choice for reserve capacity must take into account not only the capital costs of generating capacity but also the extra fuel and operating costs, the latter costs being incurred only when water intake is low. This paper describes an LP model of the long range planning problem in which the effects of both low water inflows and high water inflows are included. The formulation used to represent these variable elements in the model was designed to minimize the number of additional constraints required. (Author)

A81-31812 # Performance of VLF, LF, and MF telecommunication systems in a simulated Satellite Power System environment ascertained by experimental means. C. M. Rush, E. J. Violette, R. H. Espeland, J. C. Carroll (U.S. National Telecommunications and Information Administration, Institute for Telecommunication Sciences, Boulder, Colo.), and K. C. Allen (Boulder Experimental Studies Institute, Longmont, Colo.). *Radio Science*, vol. 16, Mar.-Apr. 1981, p. 219-234. 18 refs. Research supported by the U.S. Department of Energy.

The purpose of this paper is to describe the results of experiments undertaken to assess the potential impact of the operation of the Satellite Power System on the D and E regions of the ionosphere, and on telecommunication systems that are dependent upon the structure of the lower ionosphere. Using the high power, high-frequency transmitter facility located at Platteville, Colorado, power densities equivalent to the Satellite Power System can be delivered to heights of 70 to 100 km above the surface of the earth. Observations of the performance of telecommunication systems that operate in the VLF, LF, and MF portions of the spectrum have been investigated during times when the ionosphere was modified with power densities comparable to the Satellite Power System and when it was not. The results obtained indicate that the Satellite Power System as currently designed with a peak power density of 23 mW/sq cm is not likely to impact in an adverse manner upon the performance of VLF, LF, and MF telecommunication systems. (Author)

A81-33150 The use of airspace - One way to save fuel. J. S. Savage. *The Controller*, vol. 20, Mar. 1981, p. 9-11, 13.

An apparent disagreement between airlines and pilots on the topics of optimal fuel consumption and the present use of airspace is discussed from the viewpoint of a pilot. The problems are seen mostly in terms of restrictions imposed upon the pilot by Air Traffic Services and the Performance Management Systems of Airlines. Some requirements for an ideal flight and economic use of airspace and fuel are briefly outlined. They include: (1) air traffic control clearance to be given before the engine is started, (2) take-off, climb-out, and descent to be as unrestricted as possible, (3) initial cruise at optimum level for fuel economy and access to higher levels as weight is reduced, (4) freedom to deviate from track to avoid weather build-ups. To economize fuel consumption a complete redesigning of airways and the introduction of one way airways in areas of high traffic density is proposed. Comparative data are given to support the proposal with regard to actual fuel cost savings during climb and descent phases and cruising. E B

A81-33269 Solar access - Is there a shining future. L. Heller (U.S. Department of Energy, Washington, D.C.). *Northrop*

University Law Journal of Aerospace, Energy, and the Environment, vol. 2, Sept. 1980, p. 1-13. 69 refs.

Legal implications of the question of safeguarding access to solar energy are discussed as increased U.S. per capita use and population growth has led to energy dependence and the search for alternatives. Solar energy is a constant and renewable source but there must be an adequate legal structure. Legislation must provide protection and incentives. Major Federal legislation was passed in 1974 and by the end of 1979 at least forty states had passed development related legislation. The access question involves consideration of available types of solar systems and variations in the siting of the units. Zoning regulations are considered effective for encouraging solar use and protecting access. The legal right to sunlight access is not recognized in the U.S. and access may be blocked by adjacent structures. This is the central solar access question. The British Doctrine of Ancient Lights granting rights after 27 years of use was proposed as a basis for U.S. Legislation but is not acceptable. Analogies with radio and television reception, water rights, and nuisance law have been considered. The recommended approach combines government protective regulation and incentives along with voluntary private agreements. Easements for access can be negotiated and zoning and land use planning can take solar use into consideration. D B

A81-33270 Can solar access rights be protected by a revival of the Doctrine of Ancient Lights. R. B. Weiss. *Northrop University Law Journal of Aerospace, Energy, and the Environment*, vol. 2, Sept. 1980, p. 23-33. 71 refs.

Property owners' rights to solar access are examined since this is a decisive factor in solar development. The history of solar access rights is reviewed from the British Doctrine of Ancient Lights specifying property owners rights to light provided that they have already done so for a specific period defined by the 1959 Rights of Light Act as twenty seven years. American law at first followed British law but later rejected this right and U.S. courts have not recognized solar access rights. The Solar Energy Act was passed in 1974 and Federal and state legislation is necessary to create the protection essential to development. One bill on access rights has been introduced. Some states have enacted legislation regulating solar access. A model solar air rights bill is proposed. D B

A81-33271 Solar access protection, energy policy and the zoning process. J. Hirschen. *Northrop University Law Journal of Aerospace, Energy, and the Environment*, vol. 2, Sept. 1980, p. 35-47. 96 refs.

It is suggested that existing zoning structures can be easily adapted to the role of solar access protection. The modification of conventional zoning, accomplished with newer land use concepts, such as transferable development rights, will help to overcome its inherent weaknesses of lack of flexibility and potential inequity. When state and federal energy policies are considered in their proper perspective by zoning agencies, existing zoning structures can be implemented in a way that avoids any barriers to solar collector installations. In this way, the zoning process will be an extremely valuable aid to the encouragement, promotion, and protection of solar power installations, contributing directly toward the conservation of energy resources. B J

A81-33272 Public nuisance law as it relates to solar energy. T. T. Moreno. *Northrop University Law Journal of Aerospace, Energy, and the Environment*, vol. 2, Sept. 1980, p. 49-59. 43 refs.

At the present time there is little, if any, protection of the right to solar access once a solar energy system has been installed. Without the needed protection, a costly solar energy system could be rendered useless by shade from a neighboring landowner. It is suggested that the development of comprehensive public nuisance law to control shading could fill the void in the protection of solar access rights. The implementation of public nuisance laws as the means to control shading of solar energy systems would be advantageous because it could be applied uniformly on a statewide basis, yet would allow more individuality than a national enactment. B J

A81-33273 Water rights as applied to solar energy protection. C. Pentis. *Northrop University Law Journal of Aerospace, Energy, and the Environment*, vol. 2, Sept. 1980, p. 61-69. 49 refs.

It is suggested that solar rights can be defined as the rights to the solar energy that would fall on one's property if the path of sunshine were not impeded by one's neighbor. A workable solar rights policy might use water rights (i.e., the right to use the water of a natural stream or water furnished through a ditch or canal for general or specific purposes) as the model. The history and current status of water rights are reviewed, and the application of water rights to a method of establishing solar energy rights is considered. B J

A81-33274 A synopsis of Federal solar energy legislation. R K Powlan. *Northrop University Law Journal of Aerospace, Energy, and the Environment*, vol 2, Sept 1980, p 71-83. 92 refs.

Existing Federal legislation that pertains to the solar energy industry is reviewed. Particular consideration is given to Title 7 of the United States Code which codifies a great many statutes to help the expansion of the solar energy industry, Title 15 of the Code which authorizes the Small Business Administration to enter into loans aiding the solar energy industry, and Title 42 of the Code which deals with many statutes concerning almost every conceivable application of solar energy and related problems. It is concluded that Federal legislation dealing with the problems of solar energy is extensive and multifaceted. There are no fewer than three Federal information agencies designed to collect and distribute information, i.e., the Solar Photovoltaic Energy Advisory Committee, the Solar Energy Research Institute, and the Solar Information Data Bank. B J

A81-33315 # Stack gas desulphurization recovery processes in thermal power plants of the world I - Processes based on absorption in aqueous solutions. S Kumar (Banaras Hindu University, Varanasi, India). *Indian Journal of Environmental Protection*, vol 1, Jan 1981, p 46-62. 45 refs.

A81-33883 # Energy modeling for aviation fuel efficiency. B P Collins (Mitre Corp., McLean, Va.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0789*. 11 p. 10 refs. U.S. Department of Transportation Contract No. RS57-80C-00103.

The use of the energy balance concept in the analysis and determination of energy efficient flight path profiles is treated as a classical optimal control problem. An optimal energy path is initially planned, based on anticipated flight path conditions. Once the journey along the planned path is started, feedback information indicative of both progress and encountered flight conditions allows the updating of a dynamic future optimal plan and, in some cases, a modification of the optimal policy. This concept is embodied in a set of equations that can be used to analyze the energy efficiency of propeller and turbojet aircraft during various operating conditions. The set of equations comprises turbojet core, turboprop and piston-prop core equations, and turbojet fuel flow equations for idle throttle setting and maximum thrust. Q C

A81-33884 # Fuel conservation integrated into airline economics. D R Ferguson (Eastern Airlines, Inc., Miami, Fla.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0831*. 7 p. 7 refs.

A method is proposed for determining the value of time to input into the least cost method of computer-flight planning that will optimize the fuel-time trade-offs available over the planning time horizon. It provides a consistent yardstick for achieving consistency in all regimes of flight, between different aircraft types, and across a wide range of wind, temperature and weight conditions. K S

A81-34152 * Improved components for engine fuel savings. R J Antl and J E McAulay (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct 13-16, 1980, Paper 801116*. 17 p. 11 refs.

NASA programs for developing fuel saving technology include the Engine Component Improvement Project for short term improvements in existing air engines. The Performance Improvement section is to define component technologies for improving fuel efficiency for CF6, JT9D and JT8D turbofan engines. Sixteen concepts were

developed and nine were tested while four are already in use by airlines. If all sixteen concepts are successfully introduced the gain will be fuel savings of more than 6 billion gallons over the lifetime of the engines. The improvements include modifications in fans, mounts, exhaust nozzles, turbine clearance and turbine blades. D B

A81-34155 * A status report on the Energy Efficient Engine Project. L E Macioce, J W Schaefer, and N T Saunders (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct 13-16, 1980, Paper 801119*. 18 p. 18 refs.

The Energy Efficient Engine (E3) Project is directed at providing, by 1984, the advanced technologies which could be used for a new generation of fuel conservative turbofan engines. This paper summarizes the scope of the entire project and the current status of these efforts. Included is a description of the preliminary designs of the fully developed engines, the potential benefits of these advanced engines, and highlights of some of the component technology efforts conducted to date. (Author)

A81-34232 Overview of aviation energy programs and supply problems. R Bowles (U.S. Department of Energy, Washington, D.C.) and J V Cignatta (Mueller Associates, Inc., Baltimore, Md.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct 13-16, 1980, Paper 801230*. 14 p. 42 refs.

In order for aviation to remain an efficient, cost effective means of transportation, a comprehensive and systematic program to alleviate the industry's petroleum dependency is necessary. This paper describes research being conducted to (1) assess problem areas affecting production of current jet aviation fuels, (2) evaluate energy conservation measures, and (3) develop alternative fuels. (Author)

A81-34542 # Applications of thermography to certain energy related problems (Applications de la thermographie à certains problèmes relatifs à l'énergie). F Foin and J Poulain (Institut Géographique National Saint Mandé, Val de Marne, France). In *International archives of photogrammetry, International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980, Presented Papers. Volume 23, Part B 7. Commission 7. Hamburg, Committee of the International Congress for Photogrammetry, 1980, p 302-307*. In French.

Methods of application of thermal mapping to thermal pollution from centralized electric power plants and building heat loss are presented. Helicopters equipped for oblique and thermographic photography have been used in 20 surveys of isotherms of sites before and after plant construction, and during nominal plant operation. Densitometry was used for interpretation when the thermography was homogeneous. This study of primary energy producers has been extended to coastically sited refineries, resulting in 2000 km of French coastline being mapped at a 1:100,000 scale. Ground truth comparisons were required for building studies to compensate for lack of uniform emissivity and it is noted that buildings with good insulation display characteristics of unheated buildings. Samples of a housing development and a central nuclear plant are provided. D H K

A81-34873 Energy analysis of coal, fission, and fusion power plants. N Tsoulfanidis (Missouri-Rolla, University, Rolla, Mo.). *Nuclear Technology/Fusion*, vol 1, Apr 1981, p 238-254. 42 refs.

The method of net energy analysis has been applied to coal, fission, and fusion power plants. Energy consumption over the lifetime of the plants has been calculated for construction, operation and maintenance, fuel, public welfare, and land use and restoration. Thermal and electric energy requirements were obtained separately for each energy consuming sector. The results of the study are presented in three ways: total energy requirements, energy gain ratio, and payback periods. All three types of power plants are net producers of energy. The coal and fusion power plants are superior to fission plants from the energy efficiency point of view. Fission plants will improve considerably if the centrifuge replaces the gaseous diffusion as a method of enrichment. (Author)

A81-34956 Atmospheric oxidation of flue gases from coal-fired power plants - A comparison between conventional and

scrubbed plumes J F Meagher, L Stockburger, III, R J Bonanno, E M Bailey, and M Luria (Tennessee Valley Authority, Div of Natural Resources Services, Muscle Shoals, Ala) *Atmospheric Environment*, vol 15, no. 5, 1981, p 749-762 28 refs Research supported by the US Environmental Protection Agency and Tennessee Valley Authority

A81-35798 Possibilities and limits concerning the substitution of oil by nuclear energy and coal (Möglichkeiten und Grenzen der Ölsubstitution durch Kernenergie und Kohle) P Penczynski (Kraftwerk Union AG, Erlangen, West Germany) *Energiawirtschaftliche Tagesfragen*, vol 31, May 1981, p 371-377 10 refs In German.

The energy situation in West Germany is discussed About 96% of the crude oil consumed has to be imported It is pointed out that this situation together with general developments concerning the diminishing petroleum resources of the world will make it necessary to replace the oil with other energy carriers Coal resources in West Germany are large enough to last for a few hundred years However, the consumption of coal as energy carrier should not exceed certain limits in connection with ecological considerations Uranium as raw material for nuclear energy must also be imported However, the quantities involved are very small, in connection with the high energy density of the material Consequently, a storage of uranium corresponding to a large amount of energy does not present any problems Various approaches for replacing oil are discussed, taking into account the heat pump, possibilities for storing electric energy generated during the night, automobiles operated with electric energy, energy carriers obtained from coal, and the direct use of coal

G R

A81-35850 Nuclear synergism - An emerging framework for energy systems A A Harms (McMaster University, Hamilton, Ontario, Canada) and W Haefele (International Institute for Applied Systems Analysis, Laxenburg, Austria, Kernforschungsanlage Jülich GmbH, Jülich, West Germany) *American Scientist*, vol 69, May-June 1981, p 310-317 31 refs

The concept of nuclear synergism is examined as a possible approach to future nuclear energy technologies more compatible with changing societal perceptions and scientific capacities which is based on the integration of complementary nuclear processes Following a review of some general principles of nucleonics and energetics, the processes involved in the three major contemporary technologies of nuclear fission, nuclear fusion and beam/accelerators are outlined, and historical proposals to combine these processes in spallation-fission, acceleration-fusion and fusion fission hybrid systems are indicated Closer examination of hybrid and symbiotic nuclear energy options combining all three technologies leads to a demonstration of the fundamental continuum of nuclear technologies, and design options for the degree of integration and specific subtechnologies of a synergistic system are considered It is pointed out that nuclear synergism results in an increase in the number of free neutrons acting to enhance nuclear fuel breeding or nuclear energy release in heavy elements and thus in the energy sustainability and mass sustainability sought in fission or fusion systems

A L W

A81-36425 # Some more observations on solar satellites and their legal aspects I H P Diederiks-Verschoor (International Institute of Space Law, Baarn, Netherlands) In *Colloquium on The Law of Outer Space*, 23rd, Tokyo, Japan, September 21-28, 1980, Proceedings New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p 149-152 13 refs

Solar Power Satellites (SPS) are being developed to collect the sun's energy in space The satellites will be large structures stationed at the geostationary orbit with a power of about five gigawatts each, which will be transmitted to earth by microwave or laser beams Issues concerning the environmental effects, resources, industrial and management questions, international and legal affairs, and sociopolitical aspects of SPS have all been dealt with by various international treaties, but an accepted legal structure must still be established to handle the problem of SPS and the geostationary orbit, as well as to provide a delimitation of air and outer space Studies must concern not only SPS environmental effects, but its shadowing effects, its increased risk of collision, and the major radio frequency interference problems it could cause All nations could make a cooperative study of SPS, the developed countries seeing to the technical and

economic aspects involved, and the developing countries doing research in its utilization

J F

A81-36427 # Some comments on the proposal concerning elaboration of the new legal norms governing nuclear power sources use in outer space A Gorbil (Lodz, Uniwersytet, Lodz, Poland) In *Colloquium on The Law of Outer Space*, 23rd, Tokyo, Japan, September 21-28, 1980, Proceedings New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p 161-164 10 refs

A81-37113 # Fuel conservation and pollution control by MHD H K Messerle and B Campbell (Sydney, University, Sydney, Australia) *Institution of Engineers (Australia), Electrical Engineering Transactions*, vol EE 16, June 1980, p 55-58 5 refs Research supported by the Australian Research Grants Committee and University of Sydney

MHD generators, which directly convert thermal energy in a fluid into electricity, promise a more effective use of fuel for bulk power production than conventional steam plants, bettering efficiency by over 50% and reducing the generating cost by 20% Using a Rankine steam cycle, overall power plant efficiency can increase from 33% to 50%, while fuel requirements can be reduced by one third and thermal pollution by one half Since overall fuel consumption would drop, atmospheric pollution would be decreased, and coal consumption could be diverted to areas where oil is presently being used The MHD generator structure and operation are discussed, and its general system requirements are explained A table of energy use and an efficiency graph are provided for comparison purposes Work is currently being done on a 2 MW open cycle MHD generator at the University of Sydney, Australia, and computer studies are in progress to evaluate the Faraday generator performance for the experimental 2 MW facility and larger power generators with segmented sets of electrodes

J F

A81-37117 + A comparison between fuel efficiency of railway diesel and electric traction units N Howard (British Railways Board, London, England) *Institution of Engineers (Australia), Electrical Engineering Transactions*, vol EE 16, Dec 1980, p 190-195

Electric traction is shown to have higher thermal efficiency (a net gain as high as 30%) than diesel traction The input energy to drive the generators of an electric train can be obtained from any source, including nuclear heat and mechanical energy Values drawn from operational railways in Britain show that electric trains have an overall efficiency of 25% compared with 19% for diesel trains Diesel traction operation must consider oil refining, fuel handling and storage, idling and leakage, the diesel engine, the electric transmission, and a weight penalty, efficiency for electric traction weighs the factors of coal mining, generation, high voltage transmission, a 132/25 kV transformer, a 25 kV system, and the Loco traction equipment Figures for traction fuel equivalent performance show that it takes one liter of diesel fuel to equal 2.5 kWh of electrical input energy, and cost comparisons illustrate that diesel traction is 70% more expensive than electric traction Efficiency can be improved by modifications to both the vehicle and the power equipment, and considerable energy can be saved by limiting maximum speeds and making use of the energy derived from regenerative braking

J F

A81-38123 Renewable power sparks financial interest C Norman *Science*, vol 212, June 26, 1981, p 1479-1481

A legal and economic assessment is given of section 210 of the Public Utility Regulatory Practices Act (PURPA) of 1978, which guarantees a market for small electrical power producers by requiring utilities to buy from them at premium rates and, in addition, exempts them from regulatory restrictions imposed on utilities To qualify, small power producers are limited to a capacity of 80 MW at any one site, and they must use such renewable energy sources as wind, hydroelectric, biomass, solar, and waste products There is no size limit for industrial cogeneration facilities, but those that burn oil or natural gas must meet efficiency standards to qualify Section 210 has, however, been seriously challenged in the courts by utility companies viewing it as a Federal infringement of the right of States to regulate their utilities, a court ruling favorable to the utilities has

already been given in Mississippi, and similar rulings are being sought in New York O C

A81-38511 The social costs of solar energy A study of photovoltaic energy systems T L Neff (MIT, Cambridge, MA) New York and Oxford, Pergamon Press, 1981 133 p 77 refs \$18

An extensive analysis of the social costs of photovoltaic energy systems shows that there are potentially significant hazards associated with the manufacture and use of such technologies as large crystal silicon, cadmium sulfide, and gallium arsenide solar cell arrays The categories of applications considered were (1) decentralized residential installations, (2) decentralized neighborhood, commercial or industrial installations, and (3) central station plants Summary and conclusion statements are presented for occupational health, public health, environmental impacts, labor, materials and energy impacts, and implications for technological development It is thought in overview that there are reasons for optimism about the ability of photovoltaics to improve the balance of social costs and benefits in the energy sector O C

A81-38516 Wind energy An assessment of the technical and economic potential L Jarass, L Hoffmann (Regensburg, Universität, Regensburg, West Germany), A Jarass (Forschungsgesellschaft für Alternative Technologien und Wirtschaftsanalysen mbH, Regensburg, West Germany), and G Obermair (Regensburg, Universität, Regensburg, West Germany) (Translation of Windenergie - Eine systemanalytische Bewertung des technischen und wirtschaftlichen Potentials für die Stromerzeugung der Bundesrepublik Deutschland, Berlin, Springer-Verlag, 1980) Research supported by the Bundesministerium für Forschung und Technologie, Contract No ET-4085-A Berlin, Springer-Verlag, 1981 219 p 51 refs Translation \$43 75

The technical and economic possibilities of the conversion of wind energy into electrical energy in the region of 300 MW is examined A simulations model SWING (Simulation of Wind Energy Integration in the National Power Grid) is developed based on conventional systems for current conservation and wind energy production designs Wind patterns in the Federal Republic of Germany are investigated along with optimal sizes of storage systems Fuel savings are considered along with reductions in power plant performance R C

A81-39281 Financing U S energy development - An economist's perspective P Navarro *Energy Law Journal*, vol 2, no 1, 1981, p. 9-31 130 refs

Economic arguments are presented for the three financing options, related to private sector, government, and consumer An examination is conducted concerning the major legal arguments set forth by the various proponents and opponents of the project, taking into account the relationship to the economic arguments The question of the 'proper' role of regulation as a risk-spreading device is also explored Attention is given to the policy implications of the U S Circuit Court of Appeals' resolution of the Great Plains case This case is concerned with the proposed Great Plains Coal Gasification Project (GP), which is designed to produce high Btu coal gas, utilizing the Lurgi and methanation processes On December 8, 1980, the U S Circuit Court of Appeals overturned the Federal Energy Regulatory Administration's (FERC) approval of the GP financial package FERC had made the precedent setting attempt to force the gas customers of five major pipelines to finance the GP G R

A81-39695 Contribution of technological progress to energy savings and conservation to the design of new aircraft (Contribution du progrès technologique à l'économie et à la conservation de l'énergie dans la définition des avions nouveaux) G Cormery and J Rech (Société Nationale Industrielle Aérospatiale, Paris, France) *L'Aéronautique et l'Astronautique*, no 88, 1989, p 4-18 In French

Construction of new transport aircraft involves project phases lasting 3 5 years including configuration choice, market and profitability study and scale of product The constructor's technical options are sorted by optimization criteria minimizing operating costs, life cycle cost and fuel consumption and maximizing life cycle profitability Current criteria may be irrational as in case of higher speeds which led to the commercially unsuccessful Concorde Constructors must be at the international technical level as concerns computers or Mach and Reynolds number-simulation in cryogenic

wind tunnels New materials including carbon based and titanium products will be used along with numerical technology and micro processors for auto control systems Constructors will fully benefit from progress if they apply design to cost and computer assisted conception and production methods Optimization of air economics involves a relation between kilometer prices and real demand and deregulation could increase passenger use and generate new aircraft designs D B

A81-39725 * New technologies How to assess environmental effects P J Sullivan (Ball State University, Muncie, IN) and M L Lavin (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) *Environmental Science and Technology*, vol 15, Mar 1981, p 262 267 13 refs Research supported by the U S Department of Energy and NASA

A method is provided for assessing the environmental effects of a room-and-pillar mining system (RP) and a new hydraulic borehole mining system (HBM) Before environmental assessment can begin, each technology is defined in terms of its engineering characteristics at both the conceptual and preliminary design stages The mining sites are also described in order to identify the significant advantages and constraints for each system This can be a basic physical and biological survey of the region at the conceptual stage, but a more specific representation of site characteristics is required at the preliminary stage Assessment of potential environmental effects of each system at the conceptual design is critical to its hardware development and application A checklist can be used to compare and identify the negative impacts of each method, outlining the resource affected, the type of impact involved, and the exact activity causing that impact At the preliminary design stage, these impacts should be evaluated as a result of either utilization or alteration Underground coal mining systems have three major utilization impacts - the total area disturbed, the total water resources withdrawn from other uses, and the overall energy efficiency of the process - and one major alteration impact - the degradation of water quality by sedimentation and acid contamination A comparison of the RP and HBM systems shows the HBM to be an environmentally less desirable system for the Central Appalachia region J F

A81-40015 # Study of climate and the applied aspects of this study (Izucheniye klimata i ego prikladnye aspekty) E P Borisenkov (Glavnaya Geofizicheskaya Observatoriya, Leningrad, USSR) *Meteorologiya i Gidrologiya*, June 1981, p 33-48 53 refs In Russian

Climate and climate fluctuations have influenced man's activities throughout history, and have become increasingly more significant with the current growth of economic production A review is given on impact of climate on various economic activities agriculture, forestry, transportation, energetics, construction, land reclamation, public health services, and international trade A study of historical climate fluctuations shows that the rise of climate extremes is nearly synchronous with the rise of low production, famines, and other social phenomena Consideration is also given to ways in which man's activities may influence the climate, and consequently, the future standard of living The creation of an international climate information bank is encouraged, whereby the social and economic effects of climate can be evaluated on a global scale, and decisions and projects on national economics can be made to more effectively raise economic production J, F

A81-40765 # Legal aspects of the transmission of electric power by radio frequencies J Busak *ITU Telecommunication Journal*, vol 48, June 1981, p 324-327 Translation

Conversion of solar energy into another energy form is more efficient if the conversion systems are transferred into outer space, where electric power can be transmitted to the earth's surface by means of radio frequencies The radiation produced by these frequencies may have certain ecological or biological implications, which have yet to be determined by CCIR and the World Health Organization Electric power transmission systems may cause harmful interference to the radio communication services of other countries, and will have to comply with the ITU instrument provisions and WARC radio frequency regulations Systems for transmitting electric power produced in outer space are subject to the rules and principles of international law, as in the Outer Space

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Treaty, which stresses international responsibility for national activities in outer space as well as liability for damage caused by space objects. Finally, a suitable institutional form must be adopted to guarantee all states equal access to the new sources of energy. J F

N81-22051* General Electric Co., Cincinnati, Ohio
ENERGY EFFICIENT ENGINE FLIGHT PROPULSION SYSTEM: AIRCRAFT/ENGINE INTEGRATION EVALUATION Status Report, Jan 1978 - Nov 1978
 R F. Patt Jun 1980 328 p refs
 (Contract NAS3-20643)

(NASA-CR-159584, R79AEG274) Avail NTIS
 HC A15/MF A01 CSCL 21E

Results of aircraft/engine integration studies conducted on an advanced flight propulsion system are reported. Economic evaluations of the preliminary design are included and indicate that program goals will be met. Installed sfc, DQC, noise, and emissions were evaluated. Aircraft installation considerations and growth were reviewed. J M S

N81-22477* National Aeronautics and Space Administration
 Lewis Research Center, Cleveland, Ohio

REVIEW OF STAND-ALONE PHOTOVOLTAIC APPLICATION PROJECTS SPONSORED BY US DOE AND US AID

William J. Bifano 1981 12 p refs. Presented at the Ann. Conf. of the Am. Sect. of the Intern. Solar Energy Soc., Inc., Philadelphia, 26-30 May 1981.

(Contract DE-AI01-79ET-20485)

(NASA-TM-81738, DOE/NASA/20485-8, E-809) Avail NTIS
 HC A02/MF A01 CSCL 10A

Experience with dc photovoltaic systems (without backup power) and ranging in output from 23 to 3,500 peak watts, in a wide range of environmental conditions and with a wide range of insolation, is described. Cooperation of NASA with other government agencies resulted in the installation of an air pollution monitor in New Jersey, a seismic sensor in Hawaii, power for lookout towers in national forests in California, an electric power system for a Papago Indian village in Arizona, and a power system for a grain mill and water pump in Tangaya, Upper Volta. Significant operational results are discussed and system reliability is assessed for the 20 experimental systems installed since 1976. Additional systems to be installed overseas are highlighted, and economic factors are considered. A R H

N81-22485* GTE Sylvania, Inc., Towanda, Pa
CERAMIC HEAT RECUPERATORS FOR INDUSTRIAL HEAT RECOVERY Final Report

Joseph J. Cleveland, Jeffrey M. Gonzalez, Kent H. Kohnken, and Wilfred J. Rebello (PAR Enterprises, Inc., Fairfax, Va.) Aug 1980 183 p refs

(Contracts DE-AC01-76CS-40174, EX-76-C-01-2162)

(DOE/CS-40174/T2) Avail NTIS HC A09/MF A01

A cordierite (magnesium aluminum silicate) recuperator was designed for relatively small furnaces with firing rates of 0.3 MM to 0.6 MM Btu/h and with exhaust gas temperatures of 1500 F to 2800 F. Five demonstration programs were performed to determine the heat transfer performance of the device, establish the energy savings by recovery, demonstrate the durability of the ceramic core, determine the operating requirements of the burners and controls with recuperation, and establish the overall system costs and payback period. The recuperator is described and results of tests and measurements, system economics, and cost performance analyses are presented. The methodology is developed and techniques for impact analysis are described. Industrial applications are implied and a process flow diagram for smelting and refining primary copper is shown. DOE

N81-22492* Department of Natural Resources, Baton Rouge, La

OPERATIONS RESEARCH AND SYSTEMS ANALYSIS OF GEOPRESSURED-GEOTHERMAL ENERGY IN LOUISIANA

Final Report, 1 Jun. 1978 - 31 Aug. 1979

Adrain E. Johnson Jr. Nov 1980 295 p

(Contracts DE-FG08-78ET-27085, ET-78-C-08-1576)

(DOE/ET-27085/1) Avail NTIS HC A13/MF A01

A projection of the probable contribution of the geopressured-geothermal energy resource in Louisiana is compared to the overall energy requirements of the nation. Objectives were development of the tools and methodology for performing

economic analyses. Application of these tools to specific prospects about which adequate resource assessments were made. Identification of the impediments to resource development, and socio-economic analysis of the impact of development of the resource on these specific prospects. An overview of the geopressured-geothermal resource activities in Louisiana is provided. Major conclusions and findings with respect to commercial viability, impediments, and social and economic impact are presented, and recommendations made for future systems analysis. DOE

N81-22494* Churchill (Joe) Construction Inc., Macomb, Ill
LOW INFILTRATION-HIGH INSULATION HOUSE CONSTRUCTION Final Report

Joe Churchill 24 Nov 1980 11 p

(Grant DE-FG02-79RS-10111)

(DOE/R5-10111/1) Avail NTIS HC A02/MF A01

The 1440 square foot, single family house features innovative construction techniques using standard materials. Special double thick and double insulated walls were built. The ceiling was specially built and crawl space was insulated heavily and the band joist assembly was redesigned so as to eliminate the band joist and sill plate completely. These details are represented. Records were kept on energy consumption of the electric heat system, the water heater, and the air conditioner, and data on these are presented. DOE

N81-22495* Research for Growth and Transfer, Inc., Houston Tex

INTEGRATION METHODOLOGY FOR ENERGY SUPPLIES AND DEMANDS Final Report

R. G. Thompson, J. C. Stone and S. Muthukrishnan Nov 1980 84 p refs

(EPRI Proj 1149-3)

(EPRI-EA-1633) Avail NTIS HC A05/MF A01

The objective is to obtain a relatively simple system that can be readily disseminated and used extensively (and inexpensively) to provide forecasts and analysis of future movements in energy prices and quantities. The integration method is built heavily on the long standing economic principles of price theory, blending knowledge of future options and past decisions into conventional supply/demand equations. Operationally, complex models of primary energy supply, energy conversion and final demand are employed to generate a body of data on energy prices and quantities. DOE

N81-22496* Department of Energy, Washington, D. C. Office of Energy Use Analysis

RESIDENTIAL ENERGY DEMAND MODELS CURRENT STATUS AND FUTURE IMPROVEMENTS

Gerald Peabody Dec 1980 67 p refs

(DOE/EIA-0261) Avail NTIS HC A04/MF A01

Two models currently used to analyze energy use by the residential sector are described. The ORNL model is used to forecast energy use by fuel type for various end uses on a yearly basis. The MATH/CHRDS model analyzes variations in energy expenditures by households of various socioeconomic and demographic characteristics. The essential features of the ORNL and MATH/CHRDS models are retained in a proposed model and integrated into a framework that is more flexible than either model. The important determinants of energy use by households are reviewed. DOE

N81-22499* California Univ., Berkeley Energy and Environment Div

FORECASTING THE ROLE OF RENEWABLES IN HAWAII

Jayant Sathaye and Henry Ruderman Nov 1980 33 p refs

Presented at the Intern. Assoc. of Energy Economists, Washington, D.C. 5-7 Oct 1980

(Contract W-7405-eng-48)

(LBL-11903 CONF-8010152-1)

Avail NTIS

HC A03/MF A01

Alternative future energy supply systems for Hawaii were investigated. Other elements of the study examined future demand for energy, what indigenous resources are available, what technologies will be sufficiently developed to exploit them, and what will be their social, economic, and environmental consequences. Each of the four counties in the state appear to have sufficient natural resources to supply nearly all of their energy needs. The island is in the belt of the northeast trade winds.

has extensive high temperature geothermal resources, enjoys a higher average insolation than the mainland states, and the large temperature gradients and absence of a continental shelf make Hawaii a prime location for OTEC DOE

N81-22500# Wilson-Hill Associates, Inc Washington D C
ENERGY EMERGENCY MANAGEMENT INFORMATION SYSTEM (EEMIS). FUNCTIONAL REQUIREMENTS

17 Oct 1980 48 p

(Contract DE-AC01-80EI-11581)

(DOE/EIA-11581/T1) Avail NTIS HC A03/MF A01

These guidelines state that in order to create the widest practicable competition, the system's requirements with few exceptions, must be expressed in functional terms without reference to specific hardware or software products, and that wherever exceptions are made a statement of justification must be provided. In addition, these guidelines set forth a recommended maximum threshold limit of annual contract value for schedule contract procurements DOE

N81-22501# Meyer (A F) and Associates, Inc, McLean, Va
SAFETY ANALYSIS AND REVIEW SYSTEM FOR THE DEPARTMENT OF ENERGY'S FOSSIL ENERGY, PROGRAMS, PHASE 1 Quarterly Report

Ellen T Browne Dec 1980 14 p

(Contract DE-AM01-80ET-13650)

(DOE/ET-13650/1) Avail NTIS HC A02/MF A01

Work performed to date by A F Meyer and Associates Inc (AFMA) in support of SARS implementation is summarized. Under the contract, AFMA is providing technical assistance to DOE to analyze SARS data and develop recommended milestones for the Headquarters review requirements, analyze and recommend alternative procedures for conduct of such reviews and develop costs thereon, and support such Headquarters reviews and evaluate SARS activities at project and field analysis and review levels DOE

N81-22510# Midwest Research Inst, Golden, Colo Solar Energy Research Inst

MAKING SOLAR LAWS WORK: A STUDY OF STATE SOLAR ENERGY INCENTIVES VOLUME 1- EXECUTIVE SUMMARY

J D Roessner Nov 1980 39 p refs

(Contract DE-AC02-77CH-00178)

(SERI/TR-722-583-Vol-1) Avail NTIS HC A03/MF A01

The results of a research investigation of solar financial and research, demonstration, and development incentive programs in 18 states are summarized. The investigation focuses upon implementation - the organization and administrative processes required to convert a law into a viable program. Results indicate that four conditions are common to successful implementation of both types of incentive programs: the opportunity to use solar energy as a heating source; characteristics of the agency selected to complement the law; involvement of outside groups in program implementation; and the specificity of guidance given to those responsible for implementation. Other conditions specific to the implementation of each type of program are discussed as well as the implications of these findings for state and federal policy makers DOE

N81-22517# University of Southern California Los Angeles School of Architecture

SOLAR ENVELOPE CONCEPTS MODERATE DENSITY BUILDING APPLICATIONS Final Report

Ralph L Knowles and Richard D Berry Solar Energy Research Inst Apr 1980 144 p

(Contract DE-AC02-77CH-00178)

(SERI/SP-98155-1) Avail NTIS HC A07/MF A01

The public policy mechanism for guaranteeing solar access is conceptualized as a solar zoning envelope that allows the largest possible building bulk on a land parcel without shadowing neighboring properties during specified times. Step-by-step methods for generating solar envelopes are described with extensive drawings showing a variety of urban platting and lot configurations. Development and design possibilities are examined on a selected set of Los Angeles sites with typically diverse urban characteristics. Envelope attributes suitable for encouraging moderate-density commercial and residential building are examined in the context of two hypothetical but realistic development programs: one for speculative office buildings and

one for condominium housing. Numerous illustrations of envelope forms and prototypical building designs are provided DOE

N81-22520# Midwest Research Inst, Golden, Colo
CURRENT AND FUTURE INDUSTRIAL ENERGY SERVICE CHARACTERIZATIONS VOLUME 2 ENERGY DATA ON THE US MANUFACTURING SUBSECTOR Final Report

F Krawiec, Tom Thomas, Frederick Jackson, Dilip R Limaye, Steve Isser, Ken Karnofsky, and Todd D Davis Oct 1980 271 p Prepared in cooperation with Synergic Resources Corp, Bala Cynwyd Pa

(Contract DE-AC02-77CH-00178)

(SERI/TR-733-790-VOL-2) Avail NTIS HC A12/MF A01

In order to characterize industrial energy service current energy demand, its end uses, and cost of typical energy applications and resultant services in the industrial sector were examined and a projection of state industrial energy demands and prices to 1990 was developed. Volume 2 presents in Section 2 data on the US manufacturing subsector energy demand, intensity, growth rates, and cost for 1971, 1974, and 1976. These data characterize typical energy applications and the resultant service in this subsector. Section 3 presents the computer program used to produce the tabulated data DOE

N81-22521# Midwest Research Inst, Golden, Colo
CURRENT AND FUTURE INDUSTRIAL ENERGY SERVICE CHARACTERIZATIONS VOLUME 3 ENERGY DATA ON 15 SELECTED STATES MANUFACTURING SUBSECTOR Final Report

F Krawiec, Tom Thomas, Frederick Jackson, Dilip R Limaye, Steve Isser, Ken Karnofsky, and Todd D Davis Oct 1980 962 p Prepared in cooperation with Synergic Resources Corp, Bala-Cynwyd, Pa

(Contract DE-AC02-77CH-00178)

(SERI/TR-733-790-Vol-3) Avail NTIS HC A99/MF A01

An examination is made of the current and future energy demands, end uses, and cost to characterize typical applications and resulting services in the US and industrial sectors of 15 selected states. Tables containing data on selected states manufacturing subsector energy consumption, functional uses and cost in 1974 and 1976 are included. Alabama, California, Illinois, Indiana, Louisiana, Michigan, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Texas, West Virginia, and Wisconsin were chosen as having the greatest potential for replacing conventional fuel with solar energy. Basic data on the quantities, cost, and types of fuel and electric energy purchased by industry for heat and power were obtained from the 1974 and 1976 Annual Survey of Manufacturers DOE

N81-22523# Hittman Associates Inc, Columbia Md
BATTERY RESOURCE ASSESSMENT BATTERY DEMANDS SCENARIOS MATERIALS Interim Report

Daniel Sullivan Dec 1980 54 p refs

(Contract DE-AC02-80CH-10026)

(DOE/CH-10026/T4 HC2002/021-80-9921 IR-1) Avail NTIS HC A04/MF A01

Projections of demand for batteries and battery materials between 1980 and 2000 are presented. The estimates are based on existing predictions for the future of the electric vehicle, photovoltaic utility load-leveling, and existing battery industry. Battery demand was first computed as kilowatt-hours of storage for various types of batteries. Using estimates for the materials required for each battery, the maximum demand that could be expected for each battery material was determined DOE

N81-22532# Carnegie-Mellon Univ, Pittsburgh, Pa
ALTERNATIVE FUTURE SCENARIOS FOR THE SPS COMPARATIVE ASSESSMENT

R U Ayres, R G Ridker (Resources for the Future Inc), W D Watson, Jr (Geological Survey, Denver, Colo), J Arnold (Variflex Corp) and G Tayi Aug 1980 152 p refs

(Contracts W-21-109-eng-38 W-31-109-eng-38)

(ANL/EES-TM-120) Avail NTIS HC A08/MF A01

Terrestrial alternatives are selected, and their cost, performance, and environmental and social attributes are specified for use in the comparison with the SPS in the post 2000 era. Data on alternative technologies were sought from previous research and from other comparisons. The economic/energy

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interactions are discussed, and a number of specific modelling schemes that were used for long range forecasting purposes are described. This discussion provides the rationale for the choice of a specific model and methodology, which is described. Long range cost assumptions used in the forecast are detailed and the basis for the selection of specific scenarios follows. Results of the analysis are detailed. DOE

N81-22536# Department of Energy, Washington, D C Assistant Secretary of Conservation and Solar Energy
DISTRIBUTED THERMAL ENERGY STORAGE IN THE RESIDENTIAL SECTOR COMMERCIALIZATION-READINESS ASSESSMENT AND IMPLEMENTATION STRATEGY

Aug 1980 92 p

(DOE/CS-0195) Avail NTIS HC A05/MF A01

It was concluded that TES systems for residential space and hot-water heating are technically and economically ready for commercialization. TES systems are unlikely to be more attractive than standard-heat-pump systems in all areas of the country; however, in many regions, particularly in the northeast and north central states, TES appears to be more attractive. Environmental, market and economic, and institutional-readiness studies are presented. Market penetration and benefit analysis are summarized. Barriers to commercialization are identified along with strategies for overcoming the barriers. Schedules and resource requirements are discussed. DOE

N81-22539# Oak Ridge National Lab Tenn
FOSSIL ENERGY PROGRAM Progress Report
L E McNeese Feb 1981 124 p refs
(Contract W-7405-eng-26)

(ORNL/TM-7682) Avail NTIS HC A06/MF A01

The projects reported include those for coal conversion development, chemical research and development, materials technology, component development and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluations, fossil energy environmental analysis, flue gas desulfurization plant control development, atmospheric fluidized bed coal combustor for cogeneration, TVA FBC demonstration plant program technical support, and PFBC systems analysis. Fossil fuel application assessments, performance assurance system support for fossil energy projects, international energy technology assessment and general equilibrium models of liquid and gaseous fuel supplies are presented. DOE

N81-22541# Oak Ridge National Lab Tenn Energy Div
PERFORMANCE AND ECONOMICS OF THE ACES AND ALTERNATIVE RESIDENTIAL HEATING AND AIR CONDITIONING SYSTEMS IN 116 US CITIES

L A Abbatiello, E A Nephew, and M L Ballou Mar 1981 237 p refs
(Contract W-7405-eng-26)

(ORNL/CON-52) Avail NTIS HC A11/MF A01

The efficiency and life cycle costs of the brine chiller minimal annual cycle energy system (ACES) for residential space heating, air conditioning, and water heating requirements are compared with three conventional systems. The conventional systems evaluated are a high performance air-to-air heat pump with an electric resistance water heater, an electric furnace with a central air conditioner and an electric resistance water heater, and a high performance air-to-air heat pump with a superheater unit for hot water production. Monthly energy requirements for a reference single family house are calculated and the initial cost and annual energy consumption of the systems providing identical energy services are computed and compared. The ACES consumes one third to one half of the electrical energy required by the conventional systems and delivers the same annual loads at comparable costs. J D H

N81-22548# Midwest Research Inst, Golden, Colo Solar Energy Research Inst
ECONOMIC ANALYSIS OF COMMUNITY SOLAR HEATING SYSTEMS THAT USE ANNUAL CYCLE THERMAL ENERGY STORAGE

F Baylin, R Monte, S Sillman, F C Hooper, and J D McClenahan Feb 1981 44 p refs Prepared in cooperation with Toronto Univ Ontario

(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/TR-721-898) Avail NTIS HC A03/MF A01

Systems were sized for three housing configurations: single unit dwellings, 10 unit and 200 unit apartment complexes in 50, 200, 400, and 1000 unit communities in 10 geographic locations in the United States. Thermal energy is stored in large, constructed underground tanks. Costs were assigned to each component of every system in order to allow calculation of total costs. Results are presented as normalized system costs per unit of heat delivered per building unit. These methods allow identification of the relative importance of each system component in the overall cost and identification of the key variables that determine the optimum sizing of a district solar heating system. DOE

N81-22550# Midwest Research Inst Golden, Colo International Div

SOLAR ENERGY IN ARGENTINA. A PROFILE OF RENEWABLE ENERGY ACTIVITY IN ITS NATIONAL CONTEXT

Donna Hawkins Jan 1981 50 p refs

(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/SP-763-719, SERI/SP-763-1002) Avail NTIS HC A03/MF A01

The following subjects are covered: The country overview, the energy summary, the geopolitical, economic, and cultural aspects of the Republic of Argentina, the energy profile and international contacts, manufacturers and projects. DOE

N81-22556# Westinghouse Electric Corp Pittsburgh Pa Advanced Systems Technology Div
ECONOMIC ASSESSMENT PHOTOVOLTAIC/BATTERY SYSTEMS Final Report

J T Day, T P Hayes, and W J Hobbs Feb 1981 132 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-7083) Avail NTIS HC A07/MF A01

The economics of residential PV/battery systems were determined from the utility perspective using detailed computer simulation to determine marginal costs. Brief consideration is also given to the economics of customer ownership, utility distribution system impact and the implications of PURPA. DOE

N81-22559# Battelle Pacific Northwest Labs, Richland, Wash Pacific Northwest Lab

SUMMARY OF THREE REGIONAL ASSESSMENT STUDIES OF SOLAR ELECTRIC GENERATION OPPORTUNITIES IN THE SOUTHWEST, SOUTHEAST, AND NORTHEAST UNITED STATES

R L Watts and H Harty Feb 1981 38 p refs

(Contract DE-AC06-76RL-01830)

(PNL-3030) Avail NTIS HC A03/MF A01

The evaluations were based on both economic analyses and user perception of what they would require to select or approve the use of solar electric generation for themselves or for their employers. Over 30 utilities and several industrial and commercial firms and homeowners were involved. Solar electric technologies considered included biomass, hybrid retrofit, OTEC, photovoltaic, solar thermal, and wind. The studies projected that solar electric technologies could account for several percent of the forecast generation in year 2000 in the Southeast and Southwest regions, and up to 10 to 20% in the Northeast region. DOE

N81-22561# PRC Toups, Orange Calif

GEOTHERMAL SPACE HEATING APPLICATIONS FOR THE FORT BECK INDIAN RESERVATION IN THE VICINITY OF POPLAR, MONTANA Final Report, 20 Aug. 1979 - 31 May 1980

J H Birman, Jane Cohen, and Glenn J Spencer Oct 1980 177 p refs

(Contract DE-FC07-79ID-12046)

(DOE/ID-12046/4) Avail NTIS HC A09/MF A01

A preliminary assessment of the resource characteristics, a preliminary design and economic evaluation of a geothermal heating district and an analysis of environmental and institutional issues are included. Preliminary investigations were also made into possible additional uses of the geothermal resource, including ethanol production. The preliminary heating district system effort for the town of Poplar included design heat load estimates, a field development concept, and preliminary design of heat extraction and hot water distribution systems. DOE

N81-22576# Du Pont de Nemours (E I) and Co., Wilmington, Del

SYNFUEL PROGRAM ANALYSIS VOLUME 1. PROCEDURES-CAPABILITIES

J B Muddiman and J W Whelan Jul 1980 119 p refs 2 Vol

(Contract DE-AC09-76SR-00001)

(DOE/RA-00001/T5-Vol-1) Avail NTIS HC A06/MF A01

The analytic procedures and capabilities developed by Resource Applications (RA) for examining the economic viability public costs, and national benefits of alternative are described This volume is intended for Department of Energy (DOE) and Synthetic Fuel Corporation (SFC) program management personnel and includes a general description of the costing, venture and portfolio models with enough detail for the reader to be able to specify cases and interpret outputs It contains an explicit description (with examples) of the types of results which can be obtained when applied for the analysis of individual projects the analysis of input uncertainty, i.e., risk, and the analysis of portfolios of such projects, including varying technology mixes and buildup schedules The objective is to obtain on the one hand comparative measures of private investment requirements and expected returns (under differing public policies) as they affect the private decision to proceed, and, on the other, public costs and national benefits as they affect public decisions to participate (in what form, in what areas, and to what extent)

DOE

N81-22599# Physical Sciences Inc., Woburn, Mass

SYNTHETIC FUEL COMBUSTION POLLUTANT FORMATION SOOT INITIATION MECHANISMS IN BURNING AROMATICS Quarterly Report, 19 Sep - 31 Dec 1980

W T Rawlins and T Tanzawa Jan 1981 33 p refs

(Contract DE-AC22-80PC-30292)

(DOE/PC-30292/1) Avail NTIS HC A03/MF A01

The design and configuration of the experimental apparatus are described The details of a kinetic model are outlined and possible reaction pathways are discussed The experiments are performed in a shock tube over the temperature range 1300 to 2500 K using multiple ultraviolet visible, and infrared diagnostics to monitor the kinetic behavior of free radicals (such as OH) incipient soot particles and combustion products Experiments are conducted with artificially enhanced concentrations of free radicals such as OH and O to determine their effects on the kinetics of soot and soot precursors

DOE

N81-22601# Department of Energy, Washington, D C Regional Impacts Div

MATRIX METHODS TO ANALYZE LONG-RANGE TRANSPORT OF AIR POLLUTANTS

Richard H Ball Jay Arnold (The Aerospace Corp) A Bruce Crane (The Aerospace Corp) Ronald E Meyers (Brookhaven National Lab), Lawrence Kleinman (Brookhaven National Lab) Thomas Carney (Brookhaven National Lab) William J Eadie (Battelle Pacific Northwest Lab), and William E Davis (Battelle Pacific Northwest Lab) Jan 1981 119 p refs

(DOE/EV-0127) Avail NTIS HC A06/MF A01

Development of the air transport matrix method was undertaken to assess air quality constraints and impacts of energy activities The method represent results of comprehensive long range transport models in a simple easy to use form The concept and methodologies used in developing matrices, a preliminary analysis of those matrices and their properties and a guide to the types of applications they can serve are presented Matrices were generated for transport of sulfur oxide emissions among the 238 Air Quality Control Regions (AQCR) in the conterminous United States, using the AIRSOX model The long range transport model and a streamlined calculation method were used to generate matrices for sulfur oxides and for emitted fine particulates Matrices were also completed for 4 months of meteorological data (one in each season) from 1974 Matrices are separated according to three categories of sources utility industrial, and area sources They differ in terms of effective stack heights and detailed distribution of source locations within each AQCR Matrices have also been calculated at the more aggregated levels of state and Federal region boundaries

DOE

N81-22604# Los Alamos Scientific Lab N Mex
ENVIRONMENTAL AND RADIOLOGICAL SAFETY STUDIES- INTERACTION OF $^{238}\text{PuO}_2$ HEAT SOURCES WITH

TERRESTRIAL AND AQUATIC ENVIRONMENTS Progress Report, 1 Jul - 30 Sep 1980

Glenn R Waterbury, comp 30 Sep 1980 45 p refs

(LA-8664-PR) Avail NTIS HC A03/MF A01

The containers for $^{238}\text{PuO}_2$ heat sources in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with the Earth and safely contain the nuclear fuel until it is recovered The effects on the heat source of terrestrial and aquatic environments are studied to obtain data for design of safer systems The data obtained in several ongoing experiments are presented Compilations of usable data generated in each experiment are emphasized These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO_2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments

S F

N81-22606# Acurex Corp Mountain View, Calif

ADVANCED PULVERIZED COAL COMBUSTOR FOR CONTROL OF NO/SUB x/ EMISSIONS Quarterly Report, 24 Sep - 24 Dec 1980

R Pam, E K Chu, and J T Kelly 30 Jan 1981 51 p refs

(Contract DE-AC22-80PC-30296)

(DOE/PC-30296/1, QR-1) Avail NTIS HC A04/MF A01

A preliminary gas phase reaction model for predicting fuel NO sub x formation during combustion of methane fuel was constructed Predictions of NO sub x formation under stirred reactor conditions agree with existing experimental data Progress was made in formulating the changes necessary to upgrade the Acurex PROF code for use as the comprehensive data analysis tool in this program The idealized combustor was designed, and requests for bids to fabricate the combustor were submitted

DOE

N81-22609# Wyoming Univ, Laramie Dept of Geology
PUSH-PULL TEST A METHOD OF EVALUATING FORMATION ADSORPTION PARAMETERS FOR PREDICTING THE ENVIRONMENTAL EFFECTS ON IN SITU COAL GASIFICATION AND URANIUM RECOVERY

J I Drever and C R McKee Nov 1980 30 p refs Prepared

in cooperation with In situ Consulting, Laramie Wyo

(DOE/TIC-11383) Avail NTIS HC A03/MF A01

The push-pull test which is a simple injection and pumping sequence of groundwater spiked with solutes of interest, is presented as a method of determining the adsorption characteristics of a formation Adsorption properties are necessary to predict restoration from both in situ coal gasification and in situ uranium extraction Two field push-pull tests were conducted on uranium formations in Wyoming Adsorption properties estimated from these tests on the basis of a simple cell model were compared to the laboratory values In the first case excellent agreement was observed between the values estimated from the field test and the values measured in the laboratory In the second case the value determined in the laboratory was five times higher than the field value It is recommended that push-pull tests be conducted on coal formations being considered for in situ gasification in view of the great uncertainty in extrapolating laboratory adsorption properties to the field

DOE

N81-22612# Los Alamos Scientific Lab N Mex
ENVIRONMENTAL ASSESSMENT OF TRACE ELEMENTS FROM COAL COMBUSTION IN THE SEMIARID WEST, SUMMARY REPORT FOR FY 1976 - 1979 Progress Report

L E Wangen and D R Dreesen Feb 1981 23 p refs

(Contract W-7405-eng-36)

(LA-8660-MS) Avail NTIS HC A02/MF A01

The two major goals are to identify potentially hazardous trace elements in stack emissions and assess their importance with respect to deposition onto surrounding terrain and to determine which elements are mobilized in the scrubber system and ash disposal ponds at the power plant Results of dry deposition calculations, trace element measurements in air particulate, soils, and vegetation are reported pursuant to the first goal Trace elements extracted from fly ash trace element measurements in influent and effluent waters of the power plant and trace element concentrations in a specie of vegetation growing in these effluent water channels are reported pursuant to the second goal

DOE

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N81-22614# Gulf Research and Development Co., Pittsburgh Pa Chemicals and Minerals Div
EFFECTS OF COMPONENTS OF SYNFUELS ON SOOT FORMATION Quarterly Technical Progress Report, 1 Oct - 31 Dec 1980

J E Haebig and P M Goldberg Feb 1981 14 p refs
 Prepared for Pittsburgh Energy Technology Center
 (Contract DE-AC22-80PC-30307)
 (DOE/PC-30307/T1 Rept-627RM053 QTPR-1) Avail NTIS HC A02/MF A01

The relationship between the rate and amount of soot formation in the combustion of coal-derived synfuels and the chemical composition and molecular constituent of those fuels is addressed. Scoping tests were performed on components of the testing system to check their usability with higher boiling fuel oil components. The required temperature and residence times for a fuel vaporizer (to precede the burner) were determined and the fuel and air feed velocity zones for flame stability and incipient soot formation were observed in a prototype flat flame burner for several hydrocarbons and kerosene. Also the design of the pressurized burner enclosure and flow/safety systems is described. DOE

N81-22646# Argonne National Lab III Dept of Astronomy
SEARCH OF ARCHIVED DATA SOURCES FOR ROCKET EXHAUST-INDUCED MODIFICATIONS OF THE IONOSPHERE

C C Chacko and M Mendillo Sep 1980 50 p refs
 (Contract W-31-109-eng-38)
 (ANL/EES-TM-122) Avail NTIS HC A03/MF A01

A comprehensive environmental impact study was initiated that involved an unprecedented scope of concerns ranging from ground-level noise and weather modifications to possible planetary-scale perturbations caused by SPS activity in distant Earth orbits. Results of a study of an intermediate region of the Earth's environment (the ionosphere) where large-scale perturbations are caused by routine rocket activity are described. The SPS program calls for vast transportation demands into and out from the ionosphere, and thus the well-known effect of chemical depletions of the ionosphere (so-called ionospheric holes) caused by rocket exhaust signaled a concern over the possible large-scale and long-term consequences of the induced effects. DOE

N81-22679*# California Univ Davis Dept of Entomology
ENVIRONMENTAL ASSESSMENT FOR THE SATELLITE POWER SYSTEM (SPS) STUDIES OF HONEY BEES EXPOSED TO 2.45 GHz CONTINUOUS WAVE ELECTROMAGNETIC ENERGY

N E Gary and B B Westerdahl Dec 1980 147 p refs
 Sponsored in part by NASA Prepared for Argonne National Lab
 (Contract W-31-109-eng-38)
 (NASA-CR-164223 DOE/ER-0095) Avail NTIS HC A07/MF A01 CSCL 06C

Post treatment brood development was normal and teratological effects were not detected at exposures of 3 to 50 mw sq cm for 30 minutes. Post treatment survival, longevity, orientation, navigation and memory of adult bees were also normal after exposures of 3 to 50 mw sq cm for 30 minutes. Post treatment longevity of confined bees in the laboratory was normal after exposures of 3 to 50 mw sq cm for 24 hours. Thermoregulation of brood nest foraging activity, brood rearing, and social interaction were not affected by chronic exposure to 1 mw sq cm during 28 days. In dynamic behavioral bioassays the frequency of entry and duration of activity of unrestrained foraging adult bees was identical in microwave exposed areas versus control areas. DOE

N81-22694# California Univ Berkeley Lawrence Berkeley Lab
IONIZING RADIATION RISKS TO SATELLITE POWER SYSTEMS (SPS) WORKERS IN SPACE

Dec 1980 57 p refs
 (Contract W-7405-eng-48)
 (DOE/ER-0094) Avail NTIS HC A04/MF A01

The radiation risks to the health of workers who will construct and maintain solar power satellites in the space environment were studied. The major efforts were to evaluate the radiation environment estimated for the Reference System which could

represent a hazard to assess the possible somatic and genetic radiation hazards, and to estimate the risks to the health of SPS workers due to space radiation exposure and to make recommendations based on these conclusions. Details are presented. DOE

N81-22877# Argonne National Lab III Energy and Environment Systems Div
PROBLEMS ASSOCIATED WITH SOLID WASTES FROM ENERGY SYSTEMS

S Y Chiu, L Fradkin, S Barisas, T Surles, S Morris (Brookhaven National Lab), A Crowther (Brookhaven National Lab) and Vincent DeCarlo (DOE) Sep 1980 177 p refs
 (Contract W-31-109-eng-38)

(ANL/EES-TM-118) Avail NTIS HC A09/MF A01

Waste streams from many energy related technologies including oil coal, oil shale, tar sands, geothermal oil and gas extraction and nuclear power generation are reviewed with an emphasis on waste streams from coal and oil shale technologies. The available information on energy related solid wastes is outlined. Data on chemical composition and hazardous biological characteristics are included, supplemented by regulatory reviews and data on legally designated hazardous waste streams. Disposal and utilization options are provided with emphasis on solid waste disposal and recovery requirements specified under the RCRA. DOE

N81-22981# PRC Energy Analysis Co., Los Angeles Calif
DETERMINANTS OF A STRATEGY FOR INTERNATIONAL PARTICIPATION IN AN SPS PROGRAM

Alan P Daurio Dec 1980 53 p refs
 (Contract DE-AC01-79ER-10041)
 (DOE/ER-10041/T14) Avail NTIS HC A04/MF A01

Factors involved in developing a strategy of widespread international participation in the Solar Power Satellite System are surveyed. Western industrialized countries and developing nations are included. Emphasis is placed on US recognition of the technical and institutional barriers to foreign participation, such as rectenna land requirements and the limitations on the sharing of technology and manufacturing responsibilities. Other factors reviewed include (1) geographical and siting problems, (2) electricity supply and demand forecasts, (3) orbital limitations due to the number of nations making claims to the GEO orbit segment, (4) organizational problems affecting European involvement in any research and development and commercialization effort, and (5) industrial capacity. J M S

N81-23592# Bureau of Mines, Pittsburgh Pa
GUIDE TO SUBSTATION GROUNDING AND BONDING FOR MINE POWER SYSTEMS

Wils L Cooley and Roger L King 1980 34 p refs
 (PB81-148264 BM-R1-IC-8835) Avail NTIS HC A03/MF A01 CSCL 081

Specific engineering information is provided for the mining industry. Using as little theory as possible the guide lines are general enough to cover most substations, but specific enough to provide direct help with each substation. Practice is recommended that is in agreement with present Federal rules and regulations. GRA

N81-23594*# Argonne National Lab, III Energy and Environmental Systems Div
HEALTH AND SAFETY PRELIMINARY COMPARATIVE ASSESSMENT OF THE SATELLITE POWER SYSTEM (SPS) AND OTHER ENERGY ALTERNATIVES

L J Habegger, J R Gasper and C Brown Apr 1980 134 p refs
 Sponsored in cooperation with NASA
 (Contract W-31-109-eng-38)
 (NASA-CR-164215 DOE/ER-0053) Avail NTIS HC A07/MF A01 CSCL 10A

Data readily available from the literature were used to make an initial comparison of the health and safety risks of a fission power system with fuel reprocessing, a combined-cycle coal power system with a low-Btu gasifier and open-cycle gas turbine, a central-station, terrestrial, solar photovoltaic power system, the satellite power system and a first-generation fusion system. The assessment approach consists of the identification of health and safety issues in each phase of the energy cycle from raw material extraction through electrical generation, waste disposal and system deactivation, quantitative or qualitative evaluation of

impact severity and the rating of each issue with regard to known or potential impact level and level of uncertainty TM

N81-23605*# International Business Machines Corp Huntsville, Ala Federal Systems Div
SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FOR WORMSER COLUMBIA, SOUTH CAROLINA Final Report
Sep 1980 102 p refs
(Contract NAS8-32036)
(NASA-CR-161722) Avail NTIS HC A06/MF A01 CSCL 10A

The Solar Energy System is not economically beneficial under the assumed economic conditions at the sites considered. Economic benefits from this system depend on decreasing the initial investment and the continued increase in the cost of conventional energy. Decreasing the cost depends on favorable tax treatment and continuing development of solar energy technology. Fuel cost would have to increase drastically while the cost of the system would have to remain constant or decrease for the system to become economically feasible LFM

N81-23607*# International Business Machines Corp Huntsville, Ala Federal Systems Div
SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FOR COLT PUEBLO, PUEBLO, COLORADO Final Report
Sep 1980 108 p refs
(Contract NAS8-32036)
(NASA-CR-161725) Avail NTIS HC A06/MF A01 CSCL 10A

The Solar Energy System is not economically beneficial under the assumed economic conditions at Pueblo Colorado Yosemite, California, Albuquerque New Mexico Fort Worth Texas and Washington, D C. Economic benefits from this system depend on decreasing the initial investment and the continued increase in the cost of conventional energy. Decreasing the cost depends on favorable tax treatment and continuing development of solar energy technology. Fuel cost would have to increase drastically while the cost of the system would have to remain constant or decrease for the system to become economically feasible LFM

N81-23635# Eisenstadt (Melvin) and Associates Inc Albuquerque, N Mex
ACCESS TO SOLAR ENERGY THE PROBLEM AND ITS CURRENT STATUS
Melvin Eisenstadt Mar 1981 48 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7081) Avail NTIS HC A03/MF A01

The problems of providing access to sunshine for solar energy systems are addressed. Legal methods for providing such access including easements restrictive covenants, subdivision statutes and ordinances, nuisance laws permit systems state statutes creating solar access rights and zoning are analyzed. Some methods protect solar access for potential solar collector sites as well as existing collectors, while others are usable only for collectors that are already installed. The different states counties, and municipalities that use the various methods are identified. While each of the methods has its problems, zoning appears to be emerging as the most popular. For this reason zoning for solar access is discussed in some detail DOE

N81-23639# Hittman Associates Inc Columbia Md
MODELS FOR RESIDENTIAL-AND COMMERCIAL-SECTOR ENERGY CONSERVATION ANALYSIS APPLICATIONS, LIMITATIONS, AND FUTURE POTENTIAL Final Report
Henry E Cole and Robert E Fuller Sep 1980 193 p refs
(Contract DE-AC01-79PE-70044)
(DOE/PE-70044/T3 H-C1011/002-80-948F) Avail NTIS HC A09/MF A01

Four of the major models used by DOE for energy conservation analyses in the residential and commercial building sectors are reviewed and critically analyzed to determine how these models can serve as tools for DOE and its Conservation Policy Office in evaluating and quantifying their policy and program requirements. The most effective role for each model in addressing future issues of buildings energy conservation policy and analysis is assessed. The four models covered are Oak Ridge Residential Energy Model Micro Analysis of Transfers to Households/ Comprehensive Human Resources Data System (MATH/CHRS) Model Oak Ridge Commercial Energy Model and Brookhaven

Buildings Energy Conservation Optimization Model (BECOM)

DOE

N81-23640# Rockwell International Corp Canoga Park, Calif Energy Systems Group
FINANCIAL STUDY OF COMMERCIALIZATION OF SOLAR CENTRAL RECEIVER POWER SYSTEMS Final Report
Mar 1981 104 p refs
(Contract DE-AC03-80SF-11421)
(DOE/SF-11421/1, ESG-80-38) Avail NTIS HC A06/MF A01

Commercialization requires that central receiver (CR) systems meet the economic criteria used by industry to select systems for capital ventures. Quantitative estimates are given of the investment required by government utilities, and the manufacturing sector to meet the energy displacement goals for central receiver technology. Initial solar repowering and stand-alone electric utility plants will not have economic comparability with competitive energy sources. A major factor for this is that initial (first of a kind) heliostat costs will be high. As heliostat costs are reduced due to automated manufacturing economies learning and high volume production central receiver technology will become more competitive. Under this task several scenarios (0.1 0.5 and 1.0 quad/y) were evaluated to determine the effect on commercial attractiveness and to determine the cost to government to bring about commercialization of solar central receivers DOE

N81-23642# Oak Ridge Associated Universities, Tenn Inst for Energy Analysis
GLOBAL ENERGY CONSUMPTION AND PRODUCTION IN 2000
Edward L Allen Carole DAVison Rayola Dougher James A Edmonds, and John Reilly Feb 1981 57 p
(Contract DE-AC05-76OR-00033)
(ORAU/IEA-81-2(M)) Avail NTIS HC A04/MF A01

This study anticipates that global energy demand will continue to expand through 2000, although at a slower pace than in 1965 to 1978. Growth of supply is expected to be largely in conventional nonrenewable fuels - coal oil, uranium and natural gas. Energy growth is also expected to slow down in terms of energy consumption per unit of output as a consequence of continuing efficiency improvements, which in turn, result from higher energy prices. Slower rates of economic growth are expected in all groups of countries developed and underdeveloped DOE

N81-23643# Systems Control Inc, Palo Alto, Calif
SYSTEM INTEGRATION ISSUES OF RESIDENTIAL SOLAR PHOTOVOLTAIC SYSTEMS
Zia A Yamayee and John Peschon Mar 1980 99 p refs
(Contract DE-AC01-79ET-29349)
(DOE/RA-29349/01) Avail NTIS HC A05/MF A01

The economic effects of residential solar PV systems on the utility's revenue, capacity and energy requirements from the electric utility's perspective are evaluated. The price that it might pay for surplus energy and what it would charge for deficits are compared. The power and energy generated by the solar PV systems reduce the capital and operating costs that would otherwise be incurred by the utility. These avoided costs suggest what the utility might pay for surplus solar PV energy. The avoided costs are evaluated under three integration hypotheses: namely (1) the utility has no system storage (2) the utility has system storage and (3) the solar PV systems are supported by dedicated storage devices the purpose of which is to minimize sales to and purchases from the utility DOE

N81-23645# Little (Arthur D) Inc Cambridge Mass
LARGE WIND TURBINE GENERATOR PERFORMANCE ASSESSMENT Interim Status Report, No 2
W A Vachon Dec 1980 77 p refs Sponsored by Electric Power Research Inst
(EPRI Proj 1348-1)
(EPRI-AP-1641 TSR-2) Avail NTIS HC A05/MF A01

This report is the second in a series documenting a project whose main objective is to communicate the significant results of federal and privately funded large wind turbine (WT) generator development and field tests. This information is being communicated primarily to the electric utility industry DOE

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N81-23654# Department of Energy, Washington, D C Energy Information Administration

SHORT-TERM ENERGY OUTLOOK VOLUME 2 METHODOLOGY

Aug 1980 73 p refs Sponsored by DOE

(DOE/EIA-0202/4-Vol-2) Avail NTIS HC A04/MF A01

Volume II includes sections on the Short-Term Integrated Forecasting System (STIFS), on Factors Affecting the Level of Primary Petroleum Inventories and on the Forecasting Methodology for Petroleum Balances in STIFS Natural gas and residual fuel oil pricing, modeling of petroleum-product and electricity demands are included The Appendix provides a table of the conversion factors used in the STIFS system DOE

N81-23655# Department of Energy, Washington D C Office of Market Analysis

INTERNATIONAL ENERGY INDICATORS

Elizabeth K Bauer, ed Feb 1981 29 p

(DOE/IA-0010/8) Avail NTIS HC A03/MF A01

Extensive data are compiled for energy on the international scene and for the US Data included are world crude oil production, 1975 to date Iran crude oil capacity, production, and shut-in 1974 to date Saudi Arabia crude oil capacity, production, and shut-in 1974 to date, OPEC (Ex-Iran and Saudi Arabia) capacity, production, and shut-in 1974 to date oil stocks Free World, US, Japan and Europe (landed), 1973 to date petroleum consumption by industrial countries, 1973 to date USSR crude oil production 1974 to date, Free World and US nuclear generation capacity, 1973 to date Data are supplied specifically for the US on US gross imports of crude oil and products 1973 to date landed cost of Saudi crude in current and 1974 dollars, US trade in bituminous coal, 1973 to date summary of US merchandise trade 1976 to date, and energy/GNP ratio DOE

N81-23663# Rust Engineering Co., Birmingham Ala
ADVANCED SYSTEM DEMONSTRATION FOR UTILIZATION OF BIOMASS AS AN ENERGY SOURCE VOLUME 1: SCOPE AND DESIGN CRITERIA AND PROJECT SUMMARY

Oct 1980 337 p Revised Prepared in cooperation with Wheelabrator Cleanfuel Corp 8 Vol

(Contracts DE-AC06-77ET-20055, EG-77-R-06-1036)

(DOE/ET-20055/T2-Vol-1) Avail NTIS HC A15/MF A01

A generic design is presented for biomass conversion facilities located anywhere biomass is abundant The plant, its concept of operation, and other overall information are described The capital cost estimate for the plant, and the basis upon which it was obtained are given, a schedule of key milestones and activities required to construct the plant and put it into operation is presented, and the general findings in areas that affect the viability of the project are discussed The technical design biomass study, environmental impact, commercialization, and economic factors are addressed Each major plant area and its equipment and facilities are discussed as well as noise control, reliability maintainability and safety The results of studies relating to alternatives considered for optimizing plant operation parameters and specific system process schemes are presented All economic factors that affect the feasibility and viability of the biomass project are defined and evaluated DOE

N81-23668# Wheelabrator Cleanfuel Corp Washington D C
ADVANCED SYSTEM DEMONSTRATION FOR UTILIZATION OF BIOMASS AS AN ENERGY SOURCE. EXECUTIVE SUMMARY

Oct 1980 28 p Revised Prepared in cooperation with Rust Engineering Co 8 Vol

(Contracts DE-AC06-77ET-20055, EG-77-R-06-1036)

(DOE/ET-20055/T4-Exec-Summ) Avail NTIS HC A03/MF A01

The feasibility of collecting 1000 oven dry tons of biomass per day to fuel a 510 000 lb/hr boiler operating in a cogeneration mode and producing steam and electricity was confirmed in a study based on the supply of a significant portion of the facility's biomass fuel by tree harvesting and collection operations within a 50 mile radius of the plant site These operations including transporting biomass to the conversion plant, pose no threat to the environment if good forestry practice is carefully maintained Other environmental factors relating to air and water discharges from the conversion plant pose no significant technological problems in complying with federal, state, and local regulations

at a cost that is competitive with similar costs associated with fossil fueled facilities DOE

N81-23669# TRW Energy Systems Planning Div McLean Va
CHARACTERIZATION OF ALTERNATIVE ELECTRIC GENERATION TECHNOLOGIES FOR THE SPS COMPARATIVE ASSESSMENT VOLUME 1 SUMMARY OF CENTRAL STATION TECHNOLOGIES

Aug 1980 27 p refs Prepared for Argonne National Lab, Ill (Contract W-31-109-eng-38)

(ANL/EES-TM-121-Vol-1) Avail NTIS HC A03/MF A01

The technologies selected for the detailed characterization were solar technology, terrestrial photovoltaic (200 MWe) coal technologies conventional high sulfur coal combustion with advanced fine gas desulfurization (1250 MWe) and open cycle gas turbine combined cycle plant with low Btu gasifier (1250 MWe) and nuclear technologies conventional light water reactor (1250 MWe), liquid metal fast breeder reactor (1250 MWe), and magnetic fusion reactor (1320 MWe) A brief technical summary of each power plant design is given TM

N81-23670# TRW Energy Systems Planning Div, McLean, Va
CHARACTERIZATION OF ALTERNATIVE ELECTRIC GENERATION TECHNOLOGIES SPS COMPARATIVE ASSESSMENT. VOLUME 2 CENTRAL-STATION TECHNOLOGIES

Aug 1980 252 p refs Prepared for Argonne National Lab, Ill (Contract W-31-109-eng-38)

(ANL/EES-TM-121-Vol-2) Avail NTIS HC A12/MF A01

The cost and performance (i.e. technical and environmental) characteristics of six central station energy alternatives are described The alternatives are conventional coal-fired powerplants, conventional light water reactors combined cycle powerplants with low-Btu gasifiers liquid metal fast breeder reactors, photovoltaic systems without storage and fusion reactors TM

N81-23678# Westinghouse Electric Corp, Pittsburgh, Pa
Advanced Systems Technology Div

PHOTOVOLTAIC UTILITY/CUSTOMER INTERFACE STUDY Final Report

C H Eichler, T P Hayes, M M Matthews, and V F Wilaker Dec 1980 289 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-7061) Avail NTIS HC A13/MF A01

The technical, economic, and legal and regulatory issues of interconnecting small, privately-owned, on-site photovoltaic generating systems to an electric utility are addressed Baseline residential, commercial and industrial class photovoltaic systems were developed Technical issues of concern affecting this interconnection were identified and included fault protection, undervoltage protection, lamp flicker, revenue metering, loss of synchronism, electrical safety prevention of backfeeding a de-energized utility feeder, effects of on-site generation on utility relaying schemes, effects of power conditioner harmonic distortion on the electric utility, system isolation, electromagnetic interference and site power factor as seen by the utility Typical interconnection wiring diagrams were developed for interconnecting each class of baseline photovoltaic generating system DOE

N81-23688# Department of Energy Washington, D C Assistant Secretary for Environment

COMPARING ENERGY TECHNOLOGY ALTERNATIVES FROM AN ENVIRONMENTAL PERSPECTIVE

P W House, J A Coleman, R D Shull, R W Matheny, and J C Hock Feb 1981 73 p refs

(DOE/EV-0109) Avail NTIS HC A04/MF A01

A number of individuals and organizations advocate the use of comparative formal analysis to determine which are the safest methods for producing and using energy An opposing viewpoint is presented, arguing that for technical reasons, analysis can provide no definitive or rationally credible answers to the question of overall safety Analysis has not and cannot determine the sum total of damage to human welfare and ecological communities from energy technologies Analysis has produced estimates of particular types of damage however it is impossible to make such estimates comparable and commensurate across different classes of technologies and environmental effects As a result of the deficiencies comparative analysis cannot form the basis of a credible, viable energy policy Yet, without formal comparative

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analysis how can health, safety and the natural environment be protected A method is proposed for improving the Nation's approach to this problem health and the environment should be considered as constraints on the deployment of energy technologies constraints that are embodied in Government regulations DOE

N81-23692# Argonne National Lab III Energy and Environmental Systems Div

PRELIMINARY ASSESSMENT OF THE SATELLITE POWER SYSTEM (SPS) AND SIX OTHER ENERGY TECHNOLOGIES

T Wolsko C Brown, R Cirillo, J R Gasper L J Habegger K Hub, E Levine, D Newsom, M Samsa, and E Tanzman Apr 1980 188 p refs
(Contract W-31-109-eng-38)

(ANL/AA-20) Avail NTIS HC A09/MF A01

Six alternative technologies (conventional coal combustion, light water reactor coal gasification/combined cycle, liquid metal, fast breeder reactor terrestrial photovoltaic and fusion) were compared to the SPS on the basis of available data on cost and performance, health and safety environmental welfare, resource requirements and economics These comparisons are descriptive and do not culminate in any bottom line regarding the overall viability of the SPS DOE

N81-23695# California Univ, Berkeley Energy and Environment Div

REGIONAL COMPARISONS OF ON-SITE SOLAR POTENTIAL IN THE RESIDENTIAL AND INDUSTRIAL SECTORS

Allan E Gatzke and Amy O Skewes-Cox Oct 1980 155 p refs
(Contract W-7405-eng-48)

(LBL-11789) Avail NTIS HC A08/MF A01

Regional and subregional differences in the potential development of decentralized solar technologies are studied Two sectors of the economy were selected for intensive analysis the residential and industrial sectors The sequence of analysis follows the same general steps (1) selection of appropriate prototypes within each land use sector disaggregated by census region, (2) characterization of the end-use energy demand of each prototype in order to match an appropriate decentralized solar technology to the energy demand, (3) assessment of the energy conservation potential within each prototype limited by land use patterns, technology efficiency, and variation in solar insolation and (4) evaluation of the regional and subregional differences in the land use implications of decentralized energy supply technologies that result from the combination of energy demand, energy supply potential, and the subsequent addition of increasingly more restrictive policies to increase the percent contribution of on-site solar energy DOE

N81-23720# Oak Ridge National Lab Tenn Environmental Sciences Div

ENVIRONMENTAL ISSUES AND SITE SELECTION CRITERIA FOR SMALL HYDROPOWER PROJECTS IN DEVELOPING COUNTRIES

Glenn F Cada and Frank Zadroga (National Univ, Heredia, Costa Rica) Mar 1981 55 p refs
(Contract W-7405-eng-26)

(ORNL/TM-7620, Publ-1712) Avail NTIS HC A04/MF A01

The feasibility study is the final stage of site selection, where a relatively small number of candidate Small Hydropower Projects (SHPP) sites are examined in greater detail and the best are selected for development Potential environmental impacts of SHPPs are discussed, and a checklist of environmental data that should be collected in order to judge the significance of the projected impacts is provided Recommendations are made as to the necessary training and capabilities of the personnel involved in the site selection studies and the general procedures by which the studies may be conducted DOE

N81-23722# Argonne National Lab III Energy and Environmental Systems Div

ENVIRONMENTAL ASSESSMENT OF THE US DEPARTMENT OF ENERGY ELECTRIC AND HYBRID VEHICLE PROGRAM

M K Singh, M J Bernard III W B Walsh R F Giese, J R Gasper C L Saricks, L G Hill S K Zelinger D J Lutenegeger, and R Zolomij Nov 1980 526 p refs Prepared in cooperation

with Barton-Aschman Associates, Chicago and Mittelhauser Corp Downers Grove, Ill

(Contract W-31-109-eng 38)

(ANL/CNSV-13) Avail NTIS HC A23/MF A01

This environmental assessment (EA) focuses on the long term (1985-2000) impacts of the US Department of Energy (DOE) electric and hybrid vehicle (EHV) program The goal of the program is the commercialization of (1) electric vehicles (EVs) acceptable to broad segments of the personal and commercial vehicle markets (2) hybrid vehicles (HVs) with range capabilities comparable to those of conventional vehicles (CVs) and (3) advanced EHVs completely with CVs with respect to both cost and performance Five major EHV projects were established by DOE market demonstration vehicle evaluation and improvement electric vehicle commercialization hybrid vehicle commercialization and advanced vehicle development Conclusions are made as to the effects of EV and HV commercialization on that consumption and importation of raw materials petroleum and total energy consumption ecosystems impact from the time of obtaining raw material through vehicle use and materials recycling environmental impacts on air and water quality, land use and noise health and safety aspects and socioeconomic factors DOE

N81-23725# Battelle Pacific Northwest Labs Richland, Wash EXPLORATORY BENEFIT-COST ANALYSIS OF ENVIRONMENTAL CONTROLS ON HYDROTHERMAL ENERGY

M J Scott K D Wells, J W Currie and M J King Feb 1981 113 p refs

(Contract DE-AC06-76RL-01830)

(PNL-3527) Avail NTIS HC A06/MF A01

Primary objectives were to evaluate the environmental damages caused by unregulated hydrothermal resource development, use existing environmental and economic data to estimate the dollar value of preventing expected environmental damages at two sites and compare the benefits and costs of preventing the damages The sites chosen for analyses were in the Imperial Valley at Heber and Niland California There is a high level of commercial interest in developing the Heber known geothermal resource area (KGRA) and the Salton Sea KGRA The primary impacts analyzed were those related to hydrogen sulfide (H₂S) emissions and those related to disposal of spent hydrothermal brine DOE

N81-23727# Oak Ridge National Lab Tenn Information Div

US DEPARTMENT OF ENERGY ENVIRONMENTAL COMPLIANCE PROGRAM HANDBOOK: FEDERAL REGULATIONS ON AIR QUALITY, FOSSILE ENERGY

Joy Huffstetler Bobbie Neal Collier, Kathy Brown (Tennessee Univ), and Nelda McAfee (Tennessee Univ) Feb 1981 193 p

(Contract W-7405-eng-26)

(ORNL/EIS-176) Avail NTIS HC A09/MF A01

Federal laws and regulations on management of air quality that could affect the siting construction, or operation of a fossil energy facility are identified All entries are part of a computerized data base Data summary sheets are presented DOE

N81-23734# Denver Research Inst, Colo SYMPOSIUM ON THE TRANSFER AND UTILIZATION OF PARTICULATE CONTROL TECHNOLOGY VOLUME 3. PARTICULATE CONTROL DEVICES Progress Report, Jun 1979 - Jun 1980

F P Venditti, J A Armstrong, and Michael Durham Sep 1980 549 p refs Conf held at Denver, 23-29 Jul 1979

(Grant EPA-R-805725)

(PB81-144800, EPA-600/9-80-039C-Vol-3,

IERL-RTP-1063-Vol-3) Avail NTIS HC A23/MF A01 CSCIL 13B

The application of electrostatic precipitators and baghouses to power plants was addressed Baggouses were shown to have had general success in controlling coal fired power plant emissions When operating properly, baghouses limit emissions to less than 5 mg/cu nm at pressure drops of less than 2 kPa Other topics considered include enforcement of control regulations, operation and maintenance factors and fabric filters GRA

N81-23951# Department of Energy, Washington, D C Energy Information Administration

NATIONAL ENERGY INFORMATION SYSTEM BASIC

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CONCEPTS

Jul 1980 26 p
(DOE/EIA-0229) Avail NTIS HC A03/MF A01

The basic concepts on which the National Energy Information System (NEIS) rests are described and clarified. Identified are the current state of, as well as future information gathering activities of the system. The NEIS was originally created under Congressional mandate to collect, process, and disseminate data useful for analysis of energy supply and consumption issues. An overview of NEIS, data descriptions, metadata (directories, documentation), and procedures of the NEIS system are discussed in a question-and-answer format. DOE

N81-23974# Comptroller General of the United States, Washington, D C

LEARNING TO LOOK AHEAD: THE NEED FOR A NATIONAL MATERIALS POLICY AND PLANNING PROCESS Report to the Congress

19 Apr 1979 65 p refs
(EMD-79-30) Avail NTIS HC A04/MF A01

Major materials issues facing the United States, including availability, price, national security and quality of life, are reviewed. Topics include information systems, access to materials, materials, energy and the environment, making better use of resources; and planning and administration. SF

N81-23978# Systems Control, Inc. Palo Alto, Calif
INTRODUCTION OF ELECTRIC VEHICLES INTO THE UTILITY SYSTEM. ANALYSIS OF RESEARCH NEEDS Final Report

J G Bohn and J Peschon Feb 1981 62 p refs
(EPRI Proj 1524-2)
(EPRI-EM-1716) Avail NTIS HC A04/MF A01

Electric vehicle penetration prediction models estimate that more than 13 million EVs could be in operation by the year 2000. Depending upon the timing of introduction, location and distributing of these vehicles, a utility's energy and power system could be significantly affected by this new load. Research will be required in EV load characterization and prediction, battery and battery charger technology assessment, generation transmission and distribution systems analysis, load management strategy, financial and regulatory agency perspective and utility/EV interface characterization. These projects will be accomplished through the direct involvement of those utilities that are actively interested in EV technology assessment and demonstration. DOE

N81-24017*# Jet Propulsion Lab., California Inst of Tech., Pasadena Deep Space Network Engineering Sect

COMPUTER SIMULATED BUILDING ENERGY CONSUMPTION FOR VERIFICATION OF ENERGY CONSERVATION MEASURES IN NETWORK FACILITIES

B Plankey In its Telecommun and Data Acquisition 11 Apr 1981 p 142-146 refs

Avail NTIS HC A08/MF A01 CSCL 10B

A computer program called ECPVER (Energy Consumption Program - Verification) was developed to simulate all energy loads for any number of buildings. The program computes simulated daily, monthly, and yearly energy consumption which can be compared with actual meter readings for the same time period. Such comparison can lead to validation of the model under a variety of conditions, which allows it to be used to predict future energy saving due to energy conservation measures. Predicted energy saving can then be compared with actual saving to verify the effectiveness of those energy conservation changes. This verification procedure is planned to be an important advancement in the Deep Space Network Energy Project, which seeks to reduce energy cost and consumption at all DSN Deep Space Stations. ED K

N81-24511# Northern Cheyenne Research Project, Lama Deer, Mont

HYDROLOGIC IMPACTS FROM POTENTIAL COAL STRIP MINING. NORTHERN CHEYENNE RESERVATION, VOLUME 1 Final Report, Jun. 1975 - Dec 1979

William W Woessner, Edward L Heffern, Charles Andrews, Thomas J Osborne, Jason Whiteman, Wesley Spotted Elk and Daniel Morales-Brink Feb 1981 322 p refs

(Grant EPA-R-803566)
(PB81-155061, EPA-600/7-81-004A-Vol-1) Avail NTIS

HC A14/MF A01 CSCL 08H

Data from surface water monitoring, groundwater monitoring and geologic profiles is combined to estimate potential disruptions from future coal mine development on the reservation. The data is also a technical and planning guide to the geology and water resources of the reservation. GRA

N81-24549# Department of Energy, Washington, D C Office of Program Coordination

INVENTORY OF FEDERAL ENERGY-RELATED ENVIRONMENTAL AND SAFETY RESEARCH FOR FY 1979 VOLUME 1 EXECUTIVE SUMMARY

Dec 1980 50 p refs
(DOE/EV-0057/2-Vol-1) Avail NTIS HC A03/MF A01

Research and development (R and D) categories were reorganized into three main areas: environmental and safety control technology, technology impacts overview and assessments, and biological and environmental R and D and assessments. The inventory also breaks out research sponsored by various federal agencies and the amount of funding provided by each in various research categories. The format and index system allows efficient access to information compiled. Users are able to identify projects by log agency, performing organization, principal investigator and subject. DOE

N81-24550# Department of Energy, Washington, D C Office of Program Coordination

INVENTORY OF FEDERAL ENERGY-RELATED ENVIRONMENTAL AND SAFETY RESEARCH FOR FY 1979 VOLUME 2 PROJECT LISTINGS AND INDEXES

Dec 1980 694 p refs
(DOE/EV-0057/2-Vol-2) Avail NTIS HC A99/MF A01

The research is arranged by log number, which groups the projects by reporting agency. The log number is a unique number assigned to each project from a block of numbers set aside for each contributing agency. Information elements included in the summary listings are project title, principal investigators, research organization, project number, contract number, supporting organization, funding level, related energy sources with numbers indicating percentages of effort devoted to each, and R and D categories. A brief description of each project is given and this is followed by subject index terms that were assigned for computer searching and for generating the printed subject index. DOE

N81-24560# National Conference of State Legislatures, Denver, Colo

SMALL-SCALE HYDROELECTRIC POWER IN THE PACIFIC NORTHWEST NEW IMPETUS FOR AN OLD ENERGY SOURCE

Jul 1980 134 p refs Conf held at Portland, Oreg., 12 Jul 1979

(Contract DE-FG03-78RA-23220)
(DOE/RA-23220/04 CONF-790799) Avail NTIS HC A07/MF A01

The small scale hydroelectric power policy projects of the national conference of state legislators (NCSL) was designed to assist state legislators in looking at the benefits of one alternative, small scale hydro. Because of the need for state legislative support in the development of small scale hydroelectric, NCSL, as part of its contract with the Department of Energy, conducted the following conference on small scale hydro in the Pacific Northwest. State obstacles to development and options for change available to policymakers were explored. DOE

N81-24561# National Conference of State Legislatures, Denver, Colo

SMALL-SCALE HYDROELECTRIC POWER IN THE SOUTHWEST NEW IMPETUS FOR AN OLD ENERGY SOURCE

Jun 1980 148 p refs Conf Presented at Atlanta, 14 Jun 1979

(Contract DE-FG03-78RA-23220)
(DOE/RA-23220/05, CONF-7906201) Avail NTIS HC A07/MF A01

A forum was provided for state legislators and other interested persons to discuss the problems facing small scale hydro developers, and to recommend appropriate solutions to resolve those problems. Alternative policy options were recommended for consideration by both state and federal agencies. Emphasis was placed on the legal, institutional, environmental and economic barriers at the state level, as well as the federal delays associated with licensing small scale hydro projects. Legislative resolution

of the problems and delays in small scale hydro licensing and development were also stressed DOE

N81-24562# California Univ, Livermore Lawrence Livermore Lab

ESTIMATES OF THE COST AND ENERGY CONSUMPTION OF ALUMINUM-AIR ELECTRIC VEHICLES

J F Cooper Nov 1980 39 p refs Presented at the Fall Meeting of the Electrochem Soc Hollywood Fla 5-10 Oct 1980

(Contract W-7405-eng-48)

(UCRL-84445-Rev-1 CONF-8010159-1-Rev-1) Avail NTIS HC A03/MF A01

Economic costs and primary energy consumption are estimated for general purpose electric vehicles using aluminum-air propulsion batteries within the time frame of the 1990s (earliest possible date of introduction) For an aluminum-air fuel economy of 36 tonne/km/kg-Al (optimized low-gallium alloys), a total refueling cost of 56 cents/km (1979\$) was estimated for a 127 tonne vehicle This is equivalent to \$2 to 3/gal for automobiles of the same weight with fuel economies of 13.5 to 19.3 tonne-km/liter The total primary energy consumption was estimated to be 1.3 to 1.7 kWh/km (coal) for the electric vehicle which corresponds roughly to the energy cost of the automobiles using liquid fuels synthesized from coal The energy consumption is 30 to 70 percent greater than the reference automobile using petroleum-derived gasoline DOE

N81-24564# Battelle Pacific Northwest Labs Richland, Wash
COMPARISON OF GEOTHERMAL, SOLAR, AND CONVENTIONAL SPACE HEATING COSTS IN THE UNITED STATES

C H Bloomster B A Price, and L L Fassbender 1980 5 p refs Presented at the Intern Symp Alternative Energy Sources and Technol Montreal, 28 May 1980

(Contract DE-AC06-76RL-01830)

(PNL-SA-8244 CONF-800567-4) Avail NTIS HC A02/MF A01

The costs of residential heating throughout the United States using conventional solar and geothermal energy were determined under current and projected conditions Geothermal district heating systems will become economically feasible in most urban centers north of a line extending roughly from Los Angeles to Baltimore Solar heating systems with conventional heating backup will become economically feasible throughout the country The most economical applications will be in suburban and rural areas in the intermountain West and into the Great Plains region Conventional heating will remain most economic (1) in urban centers in the South (where annual heat demand is low) (2) in Northern urban centers which are too distant from geothermal resources and (3) in suburban and rural areas with low solar insolation Conventional energy will supplement solar energy in most locations DOE

N81-24567# Solar Business Office Sacramento, Calif
COMMERCIALIZING SOLAR FOR INDUSTRY IN CALIFORNIA Final Report

J Yudelson (Energy Clinic Corp Concord, Calif) Oct 1980 7 p

(Contract DE-FG03-99CS-30284)

(DOE/CS-30284/T1) Avail NTIS HC A02/MF A01

The State of California has begun a commercialization program for increasing the rate of solar applications in industry The components of this program include low interest loans, tax credits revenue bonds and educational efforts Many California industries appear to be likely candidates for solar systems but as yet only a few companies have elected to install them The various barriers to solar use by industry are primarily perceptual and financial The emphasis of the state program for commercialization is turning increasingly towards educational seminars for industry groups and development of creative financial tools and arrangements There are a few remaining legislative changes at state and federal levels primarily involving leasing and tax laws which, if enacted, would overcome all of the remaining financial barriers to widespread adoption of solar applications by industry DOE

N81-24581# Hittman Associates, Inc Columbia, Md
MAJOR MODELS AND DATA SOURCES FOR RESIDENTIAL AND COMMERCIAL SECTOR ENERGY CONSERVATION ANALYSIS Final Report

Sep 1980 175 p refs

(Contract DE-AC01-79PE-70044)

(DOE/PE-70044/T2 H-C1011/002-80-931F) Avail NTIS HC A08/MF A01

Major models and data sources are reviewed that can be used for energy-conservation analysis in the residential and commercial sectors to provide an introduction to the information that can or is available to DOE in order to further its efforts in analyzing and quantifying their policy and program requirements Purpose, basic for model structure, policy variables and parameters level of regional sectoral and fuels details output input requirements, sources of data computer accessibility and requirements A bibliography is provided for each model and data source DOE

N81-24586# Elektowaerme-Inst Essen eV (West Germany)
POSSIBILITIES OF ENERGY RECOVERY AND INTEGRATED ENERGY SUPPLY FOR FOUNDRIES Final Report

Juergen Pautz Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 46 p refs In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-042, ISSN-0340-7608) Avail NTIS HC A03/MF A01

The energy utilization of foundries equipped with electric melting and arc furnaces was investigated Systems were studied which optimize heat economy Studies of the energy balance of arc furnaces with conventional refractory linings and with water cooled linings clearly demonstrate recovery possibilities as a function of the temperature of the waste heat Domestic water heating central heating, scrap drying and steam generator plant applications are proposed for the recovered heat A considerable overall improvement in efficiency can be achieved Author (ESA)

N81-24589# Fraunhofer-Inst fuer Bauphysik Stuttgart (West Germany)

HEAT ENERGY CONSUMPTION AND INTERMITTENT HEATING Final Report

Norbert Koenig and Christian Kupke Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 55 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-072 ISSN-0340-7608) Avail NTIS HC A04/MF A01

A quantitative assessment of the possible reduction in space heating energy consumption when using an intermittent heating mode as compared to a continuous heating mode is offered In situ measurement methods used in rooms with different heat storage capacity and different heating systems or heating appliances are described A calculation program to demonstrate the effect of system parameter variation on energy consumption is presented A comparison of experiment with calculations indicates that in an ordinary residence an energy savings of 10 to 35% can be achieved by employing an intermittent heating mode, depending on the type of wall construction and the number of hours various rooms are in use Moreover, for the heating of offices and factories, the use of electronic control systems can lead to savings of 50% in heat energy consumption

Author (ESA)

N81-24594# Department of Housing and Urban Development, Washington, D C

RESIDENTIAL ENERGY EFFICIENCY STANDARDS STUDY Final Report, Report to Congress

Jul 1980 144 p

(Contract HUD-H-5040)

(PB81-169831, HUD-PDR-614 HUD-0001733) Avail NTIS HC A07/MF A01 CSCL 05K

Six major issue areas address the concerns raised in the legislation, including the feasibility of developing an energy efficiency standard for existing units, the amount of energy that would be saved by the implementation of a mandatory standard over and above the energy savings estimated as resulting from current programs, and the impact of such a standard on individual households Other concerns are how the implementation would affect credit availability and related financial matters, how it would affect the building community, and what major administrative options are available to implement the Section 253 requirement GRA

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N81-24595# Hoffman-Muntner Corp Silver Spring Md ENVIRONMENTAL, OPERATIONAL, AND ECONOMIC ASPECTS OF THIRTEEN SELECTED ENERGY TECHNOLOGIES

Lawrence Hoffman Stephen E. Noren and Elmer C Holt Jr
Sep 1980 243 p refs
(Contract EPA-68-01-4999)
(PB81-153926 EPA-600/7-80-173) Avail NTIS
HC A11/MF A01 CSCL 10A

The environmental operational and economic aspects of thirteen current and developing technologies are examined as applied to the generation of electric power steam generation, and the conversion of fossil energy into alternative forms. The following technologies are addressed (1) Conventional Boiler (2) Diesel Engine (3) Fluidized Bed Combustion (4) Combined Cycle Systems, (5) Low/Medium Btu Gasification (6) Chemically Active Fluid Bed, (7) Indirect Coal Liquefaction, (8) High Btu Gasification, (9) Surface Shale Oil Processing (10) In situ Shale Oil Processing (11) Direct Coal Liquefaction, (12) Fuel Cells, and (13) Magnetohydrodynamics GRA

N81-24607# Los Alamos Scientific Lab N Mex SUMMARY OF THE SETTING, AIR QUALITY PROBLEMS, AND METEOROLOGICAL ACTIVITIES IN THE OIL SHALE REGION

Summer Barr and William E Clements 1981 8 p refs Presented at the Ascot Modeling Meeting, Tucson Ariz 5-6 Feb 1981 (Contract W-7405-eng-36)
(LA-UR-81-533, CONF-810218-2) Avail NTIS
HC A02/MF A01

Air quality problems in the valleys of the Uinta mountains and the Roan Ridge in the oil shale area in western Colorado and eastern Utah are discussed. A meteorological field expedition that was undertaken in August 1980 by LASL and PNL is described DOE

N81-24614# IEA Coal Research London (England) NITROGEN OXIDES FROM COAL COMBUSTION: ENVIRONMENTAL EFFECTS

Irene Smith Oct 1980 98 p refs
(ICTIS/TR-10 ISBN-92-9029-055-2) Avail NTIS
HC A05/MF A01

Recent literature on the environment effects of nitrogen oxides is reviewed and the role of coal combustion relative to other sources is ascertained. The natural occurrence and most important reactions of nitrogen oxides in the atmosphere and biosphere are outlined. Natural and anthropogenic emissions are related to the potential global problems of ozone depletion and the greenhouse effect. The analysis of emissions from various sources in different regions reveals that oil combustion (particularly from transportation in urban areas) contributes to a greater proportion of the emissions than coal in many cases. The major part of emissions due to coal combustion is from power plants and nitrogen oxide emissions from this source are therefore considered in more detail including measurements of ground level concentrations relative to those from mobile sources. The environmental effects on health plants, ecological systems and materials are studied separately. Evidence is often inconsistent and unrealistic for the purposes of assessing the effects of nitrogen oxides from coal combustion. It is difficult to isolate these effects from those of other pollutants. Air pollution legislation, including standards guidelines or objectives in different countries are then compared. Monitoring of nitrous oxide in the atmosphere along with maximum concentrations of nitric oxide and nitrogen dioxide in regions of high emissions is recommended. More data are required to assess the effects of nitrogen oxides on human health Author (ESA)

N81-24615# IEA Coal Research London (England) NITROGEN OXIDES FROM COAL COMBUSTION ABATEMENT AND CONTROL

Geoffrey F Morrison Nov 1980 87 p refs
(ICTIS/TR-11 ISBN-92-9029-058-7) Avail NTIS
HC A05/MF A01

The recent literature relating to the abatement and control of nitrogen oxides from coal fired utility boilers is reviewed. The formation and decomposition of nitrogen oxides during coal combustion are assessed and operational factors, such as air preheat excess air, furnace size and load burner design burner interaction with firing pattern and coal composition, which influence the concentration of nitrogen oxides in the flue gas

are discussed. Typical nitrogen oxide emissions from coal fired utility boilers currently in operation are included. Abatement extends to combustion modifications such as burner design two stage combustion low excess air firing flue gas recirculation and furnace design. Control covers post combustion flue gas treatment. The dry nitrogen oxide removal processes discussed include selective catalytic reduction processes, selective noncatalytic reduction processes, nonselective catalytic reduction processes, adsorption processes and a radiation process. Wet nitrogen oxide removal processes are subclassified as oxidation-absorption reduction processes absorption-reduction processes absorption-oxidation processes and oxidation-absorption processes. Conclusions show combustion modifications can reduce nitrogen oxide emissions from new coal fired utility boilers to less than 200 ppm by the mid 1980s. If even lower emissions are required by law, as is increasingly likely in some countries, the more expensive option of nitrogen oxide is required Author (ESA)

N81-24616# Radian Corp Austin Tex STUDY OF AIR POLLUTION CONTROL TECHNOLOGY. CASE STUDIES OF AIR POLLUTION CONTROL TECHNOLOGY INNOVATIONS Final Report

R L Leonard, A S Forrest, E D Gibson T A Hall, M L Personett L L Zimmerman, and S R Fernandes 13 Nov 1980 352 p
(Contract NCAQ-156-AQ-7421)

(PB81-152563 RAD-80-203-003-05 AQ-7421-158) Avail NTIS HC A16/MF A01 CSCL 13D

The results of 67 personal interviews with individuals who were involved in the development of one or more of eight control technologies are presented. The technologies studied are wet limestone flue gas desulfurization (FGD), dry FGD atmospheric fluidized bed combustion NOx control for utilities Stage 2 hydrocarbon vapor recovery three way catalysts, SOx control for copper smelters and inherently low-polluting pushing processes for coke ovens GRA

N81-24622# Radian Corp Austin Tex INTERAGENCY FLUE GAS DESULFURIZATION EVALUATION Final Report, May - Dec 1977

J C Dickerman, D H Brown, and W R Menzie Feb 1981 488 p refs
(Contract EPA-68-02-2608)

(PB81-152043 RAD-80-202-187-16-31, EPA-600/7-81-015 EPA-600-13) Avail NTIS HC A21/MF A01 CSCL 13B

Results of a 6 month study of the gas desulfurization (FGD) technology conducted by an interagency team in 1977 are given. The study was mandated by President Carter in his April 1977 National Energy Plan. The purpose of the study was to determine whether additional Federal funding would accelerate the commercialization and acceptance of FGD technology. It is concluded that FGD is the most viable short-term approach to meeting increased coal-use objectives of the National Energy Plan and specific EGD research, development, and demonstration priorities are identified GRA

N81-24626# Mississippi State Univ, Mississippi State Dept of Microbiology

FATE AND EFFECT OF OIL IN THE AQUATIC ENVIRONMENT, GULF COAST REGION Final Report

Lewis R Brown Jul 1980 306 p refs
(Contract EPA-68-01-0745)
(PB81-151045, EPA-600/3-80-058B) Avail NTIS
HC A14/MF A01 CSCL 06F

Both laboratory and field sized pilot-plant ecosystem studies are reported. Emphasis was placed on the long-term, low level chronic effects of oil pollution on the ecosystem. Of the five crudes employed in the investigation, Empire Mix crude was studied most intensively GRA

N81-24982# Brookhaven National Lab, Upton, N Y Dept of Energy and Environment PROCESS MODELS, ANALYTICAL TOOLS FOR MANAGING INDUSTRIAL ENERGY SYSTEMS

Stephen O Howe, David A Pilati, Chip Balzer, and F T Sparrow (Purdue Univ, Lafayette Ind) 1980 20 p refs Presented at the 7th Natl Conf on Energy and the Environment, Phoenix, Ariz, 30 Nov - 3 Dec 1980
(Contract DE-AC02-76CH-00016)
(BNL-28837, CONF-801171-3) Avail NTIS

HC A02/MF A01

How the process models are used to analyze industrial energy systems is described and illustrated. Following a brief overview of the industry modeling program, the general methodology of process modeling is discussed. The discussion highlights the important concepts, contents, inputs and outputs of a typical process model. A model of the US pulp and paper industry is discussed as a specific application of process modeling methodology. Applications addressed include projections of energy demand, conservation technology assessment, energy-related tax policies and sensitivity analysis. A subsequent discussion of these results supports the conclusion that industry process models are versatile and powerful tools for managing industrial energy systems. DOE

N81-24984# Public Technology Inc., Washington, D C
**EVALUATION OF WESTERN EUROPEAN TECHNOLOGIES
 IN THE FIELDS OF ENERGY AND MANAGEMENT IM-
 PROVEMENT** Final Report

May 1980 81 p
 (Grant NSF ISP-77-15089)
 (PB81-135170, NSF/RA-800268) Avail NTIS
 HC A05/MF A01 CSCL 05A

The following technologies were examined in England: public lighting, nomograms, police management training simulation software, a highway maintenance data system, fuel conservation, energy sources, traffic controls and management, low energy housing, the PRESTEL television data system, performance review methods, and a waste separation plant. Technologies observed in France included geothermal district heating, cogeneration of electricity and heating, and microprocessors for vehicle tune up and peak load control. Some systems observed in Germany included a thermobile, used to make retrofit decisions for buildings to meet Federal heat loss standards, a Federal energy policy, review new building standards, a modernization program, geoprocessing, a color printer, energy and traffic analyses, digitizing technology, and solid waste conversion. GRA

N81-25000# Battelle Southern Operations, Atlanta, Ga
**REPLICATION AND EVALUATION OF SELECTED INNOVA-
 TIONS DEVELOPED WITHIN THE URBAN TECHNOLOGY
 SYSTEM. REPORT 3: TECHNOLOGY REPLICATION
 PACKAGES** Final Report

J Mercer Mar 1980 84 p
 (Grant NSF ISP-77-13029)
 (PB81-134751, NSF/RA-800262, Rept-3) Avail NTIS
 HC A05/MF A01. Also available in set of 3 reports HC E08
 as PB81-134728-SET CSCL 05A

Three replication projects developed by the urban technology system are reported: telephone cost control innovations for implementation, solar hot water heating, and project control systems. Overall objectives of these projects are the evaluation and replication of selected innovations in local government service delivery and a determination of critical factors which enhance or impede the replication process. The solar heating package is structured to provide guidelines for implementing solar hot water heating in public housing. The project control system replication package discusses schedules, reports, and monitoring system involved project control and suggested procedure for implementing a project control system. GRA

N81-25235# Committee on Science and Technology (U S House)

OVERSIGHT ALCOHOL FUELS

Washington, DC GPO 1980 118 p. Hearing before the Subcomm on Energy Develop and Appl of the Comm on Sci and Technol, 96th Congr, 2nd Sess, no 125, 22 Feb 1980 (GPO-63-226) Avail Subcommittee on Energy Development and Applications

Industrial, agricultural, and technical witnesses discuss research, development, and demonstration needs that should be considered in reviewing the DOE budget request for the alcohol fuels and biomass programs. Physical plant planning, distillery construction, transportation systems, and materials for feedstocks for fermentation to ensure a continuous supply of alcohol products not dependent on the weather or good and bad crop years are among the factors discussed. The proper role of the agricultural sector in successfully achieving the goals of the announced alcohol program is considered. J M S

N81-25236# Committee on Energy and Natural Resources (U S Senate)

**PRODUCTION OF OIL FROM TAR SAND AND OTHER
 HYDROCARBON DEPOSITS**

Washington GPO 1980 145 p. Hearing on S 2717 and H R 7242 before the Subcomm on Energy Resources and Mater Production of the Comm on Energy and Nat Resources, 96th Congr, 2nd Sess, 4 Sep 1980 (Publ-96-148 GPO-68-638) Avail Subcommittee on Energy Resources and Materials Productions

Two bills that propose to tap America's tar sand energy resources are considered. Particular attention is given to the level of the technology base necessary to recover significant quantities of oil. It is reported that the United States possesses an estimated 30 billion barrels of tar sand oil of which approximately 2 billion barrels are recoverable with existing technology. The need to develop commercial production in this area is discussed. R C T

N81-25257# National Alcohol Fuels Commission, Washington, DC

LEGISLATIVE COMPENDIUM ALCOHOL FUELS (96TH CONGRESS)

14 Apr 1980 33 p
 (PB81-153876, NAFC-80-11) Avail NTIS HC A03/MF A01 CSCL 21D

A complete listing of all legislation introduced during the first 16 months of the 96th Congress on the subject of alcohol fuels and biomass energy, including more than 120 bills, each entry includes bill title, sponsor and certain co-sponsors, date of introduction, committee referred to, a listing of the major provisions, the federal agencies affected by the bill, and a brief history of Congressional action on the bill through April 14, 1980. All bills are cross referenced on subjects such as financial assistance, research and development, federal use of gasohol and tax incentives. GRA

N81-25372# Committee on Interstate and Foreign Commerce (U S House)

AUTOMOTIVE FUEL ECONOMY

Washington GPO 1980 122 p. Hearing on H R 6943 and H R 5140 before the Subcomm on Consumer Protection and Finance of the Comm on Interstate and Foreign Com, 96th Congr, 2nd Sess, 5 May 1980 (GPO-69-331) Avail Subcommittee on Consumer Protection and Finance

Measures to increase automotive fuel economy are discussed, including flexibility in automaker compliance with government standards. Cooperation and technology exchange with foreign car producers are proposed in order to enhance fuel economy and the job market. S F

N81-25486# National Research Inst for Mathematical Sciences, Pretoria (South Africa)

**AN APPROACH TO THE MODELLING OF THE SOUTH
 AFRICAN ENERGY ECONOMY**

J G van Zyl Jun 1980 31 p refs
 (CSIR-SWISK-16) Avail NTIS HC A03/MF A01

A normative model is introduced with detailed energy sectors. The linear programming formulation incorporates an input-output description of the economy, the time horizon being 35 years, divided into seven five-year periods. An alternative formulation of the model allows substitution to take place between compatible energy sources. The purpose of the model is to study the influence of change in price and availability of energy carriers on the attainment of an economic objective, and to derive optimal energy supply strategies. The important outputs of the model are production levels and the distribution of production between consumption and investment, with a view on the one hand to the maintenance of a desirable standard of living and on the other hand to the maintenance and expansion of production facilities. T M

N81-25506# Committee on Energy and Natural Resources (U S Senate)

PACIFIC BASIN ENERGY

Washington GPO 1980 551 p refs. Hearings on H R 7330 before the Comm on Energy and Nat Resources, 96th Congr, 2nd Sess, Honolulu, 10-11 Jul 1980 (Publ-96-145, GPO-68-055) Avail Committee on Energy and Natural Resources

Testimony is presented concerning pending legislation which provides for the assessment and development of the potential for renewable energy sources in the U S insular areas, including

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the trust territories Options for self-sufficiency throughout the Pacific basin are considered in light of rapidly escalating fuel costs
A R H

N81-25507# Committee on Science and Technology (U S House)

WIND ENERGY SYSTEMS ACT OF 1980

Washington GPO 1980 432 p Hearings before the Subcomm on Energy Develop and Appl of the Comm on Sci and Technol 96th Congr 1st Sess, no 137 18, 24, 26 Sep and 17 Oct 1979

(GPO-56-735) Avail Subcommittee on Energy Development and Applications

The establishment of a 7 year \$1 billion accelerated research and development program for windpower utilization is discussed The goals of the legislation are to make wind energy cost competitive with conventional energy sources and to have in place at the end of the 7 year program 100 megawatts of wind machine capacity At least 5 megawatts of the total would be for small wind machines
T M

N81-25509# Committee on Science and Technology (U S House)

OVERSIGHT DOE SOLAR AND CONSERVATION PROGRAMS

Washington GPO 1980 213 p refs Hearings before the Subcomm on Energy Develop and Application of the Comm on Sci and Technol 96th Congr 2nd Sess, No 157, 12 Jun and 9 Sep 1980

(GPO-65-855) Avail Subcommittee on Energy Development and Applications

The research management in the programs was examined The allocation of Federal funds was investigated with respect to the total expenditures for solar/conservation vs fossil fuels development Charts are presented which show decreases in the fraction of the budget for the programs Program goals were defined and recommendations for added private sector involvement are made
T M

N81-25518# Michigan Univ Ann Arbor Architectural Research Lab

SOLARIZATION/CONSERVATION TECHNOLOGY DEVELOPMENT PROGRAM FOR EXISTING HOUSING Progress Report

W Oberdick 1 Feb 1981 14 p
(Contract DE-FG02-80R5-10227)

(DOE/R5-10227/1) Avail NTIS HC A02/MF A01

A four month period of project organization data file examination, development of concepts and technical study of S/C components is covered At the start of the project 188 residences were considered appropriate for studying this program All of these houses in the course of three years have had code update assistance This included some conservation retrofit The city of Ann Arbor was selected for a pilot study of the RCS Audit program As of this date an initial 200 audits have been completed Also, the C D office is presently undertaking the conservation retrofit of several residences in accordance with RCS recommendations Available aerial photographs proved to be inadequate for solar site evaluation The conservation updates and the RCS audits present an opportunity for evaluation and comparisons
DOE

N81-25521# Gerber (Sherman) Northbrook, Ill
ENERGY CONSERVATION THROUGH OPTIMUM UTILIZATION OF SITE ENERGY SOURCES FOR ALL SEASON THERMAL COMFORT IN NEW RESIDENTIAL CONSTRUCTION FOR SINGLE FAMILY ATTACHED (ROWHOUSE/TOWNHOUSE) DESIGNS Interim Report

Sherman Gerber and J Peter Holsman 26 Feb 1981 16 p
(Contract DE-FG02-80R5-10215)

(DOE/R5-10215/1) Avail NTIS HC A02/MF A01

A proposed design analysis is presented of a passive solar energy efficient system for a typical three level three bedroom, two story, garage under townhouse The design incorporates the best, most performance, proven and cost effective products materials, processes technologies, and subsystems which are available today Seven distinct categories recognized for analysis are identified as the exterior environment, the interior environment, conservation of energy, natural energy utilization, auxiliary

energy utilization control and distribution systems and occupant adaptation Preliminary design features, fenestration systems, the plenum supply system, the thermal storage party fire walls, direct gain storage, the radiant comfort system and direct passive cooling systems are briefly described
DOE

N81-25536# Midwest Research Inst, Golden, Colo
ENERGY-CONSERVING AND PASSIVE-SOLAR CONSTRUCTION DETAILS

Robert D Taylor Apr 1981 29 p

(Contract DE-AC02-77CH-00178)

(SERI/SP-721-1135) Avail NTIS HC A03/MF A01

Diagrams are presented which show construction details for insulating foundations, walls, joints, roofs, and other components of energy conserving residential and light commercial buildings glazing systems installing thermal mass, rock beds, and a passive hot air collector The emphasis is on using commercially available building materials in new applications to minimize costs and maximize thermal design The costs are given which are typical of what builders have incurred in different parts of the country The thermal performance figures and comments are included
DOE

N81-25544# CCB/CUMALI Associates Oakland, Calif
UNIFIED INTERZONE AND SYSTEM COUPLING METHODOLOGY FOR BUILDING ENERGY ANALYSIS

R Sullivan, S Nozaki, and Z O Cumali 16 Feb 1981 96 p refs

(Contract DE-AC03-80SF-10840)

(DOE/SF-10840/T1) Avail NTIS HC A05/MF A01

The current techniques employed by two public domain energy analysis simulation programs DOE 1/2 (weighting factor) and BLAST (thermal balance) are discussed Although these programs perform their primary function quite well, the applicability of the methods to situations in which there exists strong coupling between the zones and systems in a building is open to question Particularly for passive solar design schemes the approximations utilized would seem to be somewhat unreliable Alternative coupling techniques are discussed which amounted to extensions of the basic algorithms involved to yield simultaneous solutions among the zones and systems Both the weighting factor and thermal balance approaches are treated in addition to the concepts of radiosity and mean radiant temperature
DOE

N81-25572# Centro Informazioni Studi Esperienze, Milan (Italy)
Documentation Service

OPTIMIZED DESIGN OF TOTAL ENERGY SYSTEMS THE RETE PROJECT

P Alia, F Dallavalle, C DeNard, F Sanson S Veneziani, and G Spagni 1980 41 p refs Presented at the 4th Intern Conf of Urban Heating, Sirmione Italy, 12-15 May 1980
(CISE-1606) Avail NTIS HC A03/MF A01

A design to optimize the utilization of primary energy sources, providing both electricity and heat, is described A project plant will be located at Reggio Emilia (Italy) Several computer analyses were performed to provide climatic data, electric and heat demand diagrams capacity dimensioning, plant operation simulation and economic analysis This design methodology makes possible a total annual efficiency of 78% and fuel savings as to a conventional system, of about 28% Different processes are used in winter or summer, consisting of optimized combinations of diesel generators, auxiliary boilers, absorption chillers, and heat pumps, producing electricity with either refrigeration or heating
Author (ESA)

N81-25573# Midwest Research Inst Golden, Colo Solar Energy Research Inst

CONSERVATION AND ALTERNATIVE FUELS IN THE TRANSPORTATION SECTOR

25 Jun 1980 439 p refs

(PB81-154098) Avail NTIS HC A19/MF A01 CSCL 10A

A set of transportation energy conservation policy initiatives is described From an energy efficiency viewpoint the efforts to improve the efficiency of automobiles, airplanes and trucks is effective Shifting passengers from automobiles and airplanes to buses and trains, and shifting freight from aircraft and trucks to trains (and where practical, marine or pipeline modes) provides the largest energy savings
GRA

N81-25574# Calculon Corp, Arlington Va
REVIEW OF THE DEPARTMENT OF ENERGY'S CONSERVA-

TION AND SOLAR ENERGY PROGRAMS A REPORT TO THE PRESIDENT AND CONGRESS Final Report

Jan 1981 80 p refs
(Contract EPA-68-02-3078)
(PB81-154015, EPA-600/7-81-001) Avail NTIS
HC A05/MF A01 CSCL 10A

Findings and views gathered during the past year on Section 2 of the Federal Nonnuclear Energy Research and Development Act (Public Law 93-577) are summarized. Individuals from various sectors of the government and private industry met in a series of workshops and held a national hearing to review Federal energy conservation and solar energy programs. The discussion focused primarily on four key issues: energy policy analysis, program evaluation, DOE state and local assistance programs research, development and application. -GRA

N81-25580# Lovelace Biomedical and Environmental Research Inst Albuquerque N Mex Inhalation Toxicology Research Inst

POTENTIAL HEALTH AND ENVIRONMENTAL EFFECTS OF DIESEL LIGHT DUTY VEHICLES

R G Cuddihy, F A Seiler, W C Griggith, B R Scott and R O McClellan Oct 1980 68 p refs
(Contract DE-AC04 76EV-01013)
(LMF-82) Avail NTIS HC A04/MF A01

Quantitative projections of changes that could occur in the levels of environmental pollutants and in the risks to humans as a result of light duty diesel vehicles are similar to risks for using gasoline engine vehicles. This assessment used current scientific information to identify new directions for DOE research programs. It includes the manufacture and service of products and facilities that are necessary to support the use of light duty diesel vehicles in the US. Socio-economic factors are included. DOE

N81-25583# California Univ Berkeley Lawrence Berkeley Lab Energy and Environment Div

ENERGY AND ENVIRONMENT DIVISION Annual Report, 1979

Jeffrey Kessel, ed and Maya Osowitt, ed Oct 1980 446 p refs
(Contract W-7405-eng-48)
(LBL-11650) Avail NTIS HC A19/MF A01

Research progress for 1979 is summarized in short reports in the following areas: Energy Analysis Program, Energy Efficient Buildings Program, Solar Energy Program, Chemical Process Research and Development Program, Environmental Research Program, combustion research, effects of pollutants on biological systems, atmospheric aerosol research, and applied research in laser spectroscopy and analytical techniques. Items within the scope of EDB have been entered individually. DOE

N81-25588# California Univ, Los Angeles Dept of Environmental Science and Engineering

ENVIRONMENTAL EFFECTS OF SOLAR-THERMAL POWER SYSTEMS- ENVIRONMENTAL CONSIDERATIONS IN SITING A SOLAR-COAL HYBRID PLANT 1 ENVIRONMENTAL ASSESSMENT

Feb 1981 176 p refs 2 Vol
(Contract DE-AC03-76SF-00012)
(UCLA-12/1282) Avail NTIS HC A09/MF A01

Environmental concerns and uncertainties unique to siting a solar-coal hybrid power plant are identified. Environmental concerns are examined in the perspective of the facility's impact on the environment, the environment's impact on the facility and intraplant impacts arising from the interaction of subsystems. The effect of the facility on the environment is dominated by the large area of land required which in turn produced significant environmental concerns in the areas of air quality, geology, hydrology, vegetation and wildlife, and aesthetics. Health and safety concerns unique to solar are associated primarily with fluid releases and misdirected heliostat reflections. The effect of the environment on the facility is dominated by air quality concerns which also dominated solar-hybrid subsystem interactions. Emissions from coal combustion and coal handling are viewed as significant problems which could compromise the efficiency of the facility. DOE

N81-25589# California Univ, Los Angeles Dept of Environmental Science and Engineering

ENVIRONMENTAL EFFECTS OF SOLAR-THERMAL POWER SYSTEMS ENVIRONMENTAL CONSIDERATIONS IN SITING A SOLAR-COAL HYBRID POWER PLANT 2. AIR-QUALITY AND METEOROLOGICAL IMPACTS

Donald B Hunsaker, Jr., Carolyn T Hunsaker and Richard L Perrine Feb 1981 102 p refs 2 Vol
(Contract DE-AC03-76SF-00012)
(UCLA-12/1283) Avail NTIS HC A06/MF A01

Environmental constraints to siting a conceptual solar-coal hybrid power plant are investigated. It was found that the hybrid plant was not likely to significantly affect either local or regional climate. Microclimatological effects would probably occur within and near the facility but the effects were not quantified. For worst-case scenarios, as much as several hundred grams of particulate matter from coal combustion might deposit on a single heliostat in a 30 day period. Salt particles deposited from cooling tower operation and off-site fugitive dust sources could add comparable amounts under their respective worst-case scenarios. Natural and fugitive emissions from coal handling could also deposit significant but unquantified amounts of matter. Thus, a worst-case estimate would be that as much as kilogram quantities of matter could be deposited per heliostat in a 30 day period. The implications of these findings are presented. DOE

N81-25642# Aspen Inst for Humanistic Studies, Boulder, Colo Div on Food, Climate and the World's Future

CLIMATE CHANGE AND SOCIETY CONSEQUENCES OF INCREASING ATMOSPHERIC CARBON DIOXIDE

William W Kellogg and Robert Schwart 1981 192 p refs
(Contract DE-AC02-79EV-10281)
(DOE/EV-10281/T3) Avail NTIS HC A09/MF A01

Current knowledge of the causes of climate change is summarized and a scenario of the future climate distribution that could prevail on a warmer Earth is presented. The impacts of climatic change in particular a global warming accompanied by a shift in rainfall patterns are considered for such vital areas as food and fiber production, water resources, natural ecological systems, fisheries, health and disease and energy demand. The political, economic, social, and ethical implications of global environmental change are discussed and national and international strategies for mitigating the impacts of climatic change or possibly averting that change altogether are evaluated. DOE

N81-25878# Public Technology, Inc Washington, D C
PRIMARY URBAN ENERGY-MANAGEMENT-PLANNING METHODOLOGY, A MANAGEMENT REPORT

Nov 1980 36 p Prepared jointly with Office of Energy Management, Dade County, Fla Joint Center for Environmental and Urban Problems, Miami New York City Energy Office, N.Y., Cooper Union, New York N.Y.
(DOE/IR-05106/1) Avail NTIS HC A03/MF A01

A Primary Urban Energy Management Planning Methodology, which provides local governments with the systematic approach for dealing with short and intermediate term urban energy management problems while at the same time laying the groundwork for the formulation of long term energy management activities is described. The five tasks of the methodology are: organizing performing an energy use and supply inventory, formulating energy management goals and objectives, developing strategies to achieve the energy management objectives, and monitoring and evaluation. DOE

N81-25881# Department of Energy, Washington, D C Office of Transportation Programs

ELECTRIC AND HYBRID VEHICLE PROGRAM FOURTH REPORT TO CONGRESS FOR FY 1980 Annual Report

Jan 1981 132 p refs
(DOE/CS-0130/4 AR-4) Avail NTIS HC A07/MF A01

Implementation of the Electric and Hybrid Vehicle Research Development and Demonstration Act of 1976 (Public Law 94-413, as amended by Public Law 95-238, referred to as the Act) is described. During FY 1980 significant progress was made toward implementing the policies established by Congress in the Act. A noticeable increase in interest was shown by both the market and the supply segments of the economy in electric and hybrid vehicles. The demonstration site operators increased in number to 68 with demonstration sites located in 94 cities across the Nation. Loan guarantees were awarded to two electric vehicle manufacturers. Research and development efforts in batteries and propulsion components, as well as total vehicle systems, continue to make progress toward providing industry with

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technology options that will result in vehicles with greater public acceptance
DOE

N81-26149# Comptroller General of the United States, Washington D C

A LOOK AT NASA'S AIRCRAFT ENERGY EFFICIENCY PROGRAM

28 Jul 1980 94 p refs

(PSAD-80-50) Avail NTIS HC A05/MF A01

The status of the program, the coordination effectiveness between NASA and the Department of Defense, the need for periodic reporting to the Congress on efforts such as ACEE, and NASA's role in aeronautical research and development were examined. Emphasis is placed on the development of technologies which would make future transport aircraft up to 50% more fuel efficient than current models
TM

N81-26294# Department of Energy, Washington, D C Residential and Commercial Data Systems Div
NONRESIDENTIAL BUILDINGS ENERGY CONSUMPTION SURVEY BUILDING CHARACTERISTICS

Mar 1981 160 p

(DOE/EIA-0246) Avail NTIS HC A08/MF A01

Data on the characteristics of nonresidential buildings in the 48 contiguous States and the District of Columbia are presented. The information was collected through personal interviews conducted with building representatives. A summary of the survey design, data collection procedures, and techniques used to convert the sample data to national estimates is given. Estimated counts and percent distributions are presented by building type for selected building characteristics. These building characteristics include location, structural features, use and occupancy characteristics, types of fuels coming into the building. The same building characteristics are given for all nonresidential buildings by square footage and year of construction
DOE

N81-26650 California Univ., San Diego
STUDIES IN ENERGY CONSERVATION AND TECHNOLOGY
Ph D Thesis

Michael Robert Brambley 1981 344 p

Avail Univ Microfilms Order No 8111884

An integrated methodology for evaluating energy conservation devices is presented. Essential features are experimental measurements of the properties of the devices, analytic models of performance over the device lifetimes, net energy analyses, economic evaluations using life cycle costing and field studies to determine actual performances. Detailed applications are presented for selected fenestration devices. General relations are derived for life cycle costs, life cycle savings and payback periods associated with energy conserving devices for consumers. These are applied for parametric evaluation of the efficacy of retrofitting ceiling insulation and fenestration devices in San Diego County. Equations are presented for estimating heat transfer through eight types of fenestrations using the properties of the shading devices and the conditions of the interior and exterior environments
Dissert Abstr

N81-26677# Battelle Pacific Northwest Labs., Richland, Wash
ECONOMICS OF GEOTHERMAL, SOLAR, AND CONVENTIONAL SPACE HEATING

Linda L. Fassbender, Clarence H. Bloomster, and Bobi A. Price 1980 4 p refs Presented at the Geothermal Resources Council Ann Meeting, Salt Lake City, 9 Sep 1980

(Contract DE-AC06-76RL-01830)

(PNL-SA-8503 CONF-800920-29) Avail NTIS HC A02/MF A01

With the recent price increases in imported oil and natural gas and the planned decontrol of domestic prices, geothermal and solar energy becomes competitive for residential space heating throughout most of the country. Geothermal energy could competitively provide about 40% of the national demand for space heat and domestic hot water (about 7 quads based on 1980 demands). Nearly all of the geothermal energy demand would be in high population density areas. Solar energy could competitively provide about 50% (about 9 quads) of the annual demand. Most of the solar energy demand would be concentrated in suburban and rural areas. Conventional energy should remain competitive for about 30% (about 5 quads) of the annual demand. Conventional energy demand would be concentrated in the South and as supplemental energy for solar/conventional systems.

Geothermal solar, and conventional energy would be equally competitive for about 20% of the annual demand, which is why the individual market shares add to 120%
DOE

N81-26581# Oak Ridge National Lab Tenn Engineering Technology Div

OVERVIEW OF THE US INDUSTRIAL THERMAL ENERGY STORAGE PROGRAM

M Olszewski 1981 13 p refs

(Contract W-7405-eng-26)

(CONF-810423-2) Avail NTIS HC A02/MF A01

Thermal energy storage can contribute to industrial conservation efforts directed at saving premium (gas and oil) fuels, which is a priority national need. This can be done by using storage to allow the recycling of industrial reject heat to reduce primary energy consumption or to allow alternate fuels to replace gas and oil. Industrial thermal energy storage efforts include three major areas: in-plant reuse of industrial reject heat, external reuse of industrial reject heat for applications in the industrial or buildings sector, and use of alternate fuels to replace gas and oil. The program currently includes engineering field tests in the brick and aluminum industries. In addition, technology transfer activities are underway in the pulp and paper industry.
DOE

N81-26584# Oak Ridge National Lab, Tenn Engineering Technology Div

NEW DIRECTIONS FOR DISTRICT HEATING IN THE UNITED STATES

M Olszewski and M A Karnitz 1981 13 p Presented at the 1st Intern Energy Agency (IEA) Conf on New Energy Conserv Technol and Their Commercialization, Berlin, 6 Apr 1981

(Contract W-7405-eng-26)

(CONF-810423-3) Avail NTIS HC A02/MF A01

A description is given of the status of major US district heating projects and the potential impact of the newly implemented US National District Heating plan. Five major district heating projects moving into the construction and demonstration phase are described. Although all have hot water distribution systems, a variety of heat sources are utilized. These include geothermal water, industrial reject heat, and utility cogeneration using coal-fired power plants.
DOE

N81-26585# Brookhaven National Lab., Upton, N Y Dept of Energy and Environment

SOLAR ASSISTED HEAT PUMP RESEARCH AND DEVELOPMENT PROGRAM IN THE UNITED STATES

J W Andrews 1980 16 p refs Presented at the Performance of Heat Pump Systems Workshop, Aachen, West Germany 8-9 May 1980 sponsored by the German Section International Solar Energy Society

(Contract DE-AC02-76CH-00016)

(BNL-27722 CONF-8005150-1) Avail NTIS HC A01/MF A01

A review of the historical progress and current status of the solar assisted heat pump research and development, supported by the United States Department of Energy, is presented. Its focus is on the need for a better source of auxiliary or backup heat than the electric resistance which has generally been assumed in computer simulations of these systems. The two leading candidates are the use of the ground as an alternate heat source/sink or storage element (ground coupling) and the use of fossil fuel burned on site (the bivalent system). The United States program emphasized ground coupling. Much of the analytical work and heat pump development is applicable to bivalent systems, and some results of this work are discussed.
DOE

N81-26586# Edgerton Germeshausen and Grier, Inc., Idaho Falls, Idaho

HYDROTHERMAL ENERGY DEVELOPMENT PROJECTS

E G DiBello 1981 4 p refs

(Contract DE-AC07-76ID-01570)

(CONF-810315-7) Avail NTIS HC A02/MF A01

The development of hydrothermal energy for direct heat applications is being accelerated by twenty-two demonstration projects that are funded on a cost sharing basis by the US Department of Energy Division of Geothermal Energy. These projects are designed to demonstrate the technical and economic feasibility of the direct use of hydrothermal resources in the United States. Engineering and economic data for the projects

are summarized. The data and experience being generated by these projects will serve as an important basis for future direct heat development. DOE

N81-26589# Committee on Banking, Finance and Urban Affairs (U S House)

COMPACT CITIES ENERGY SAVING STRATEGIES FOR THE EIGHTIES

Jul 1980 94 p refs

(PB81-152019) Avail NTIS HC A05/MF A01 CSCL 10A

Focus is on energy-saving land use patterns, how to halt urban sprawl with its excessive energy consumption. Appropriate renewable energy sources and conservation incentives for cities are discussed. GRA

N81-26590# General Accounting Office, Washington, D C
FORMULATION OF US INTERNATIONAL ENERGY POLICIES Report to the Congress

30 Sep 1980 123 p

(PB81-156051 ID-80-21) Avail NTIS HC A06/MF A01 CSCL 10A

To find out how the United States develops international energy policy, GAO reviewed five major energy issues covering the period from early 1977 through 1979. The issues are: vulnerabilities to petroleum supply interruptions; long term national security strategy on imported oil prices; export of U S oil and gas production equipment and technology to the Soviet Union; World Bank initiatives to assist in financing oil and gas exploration and development in oil-importing developing countries; and the role of gas imports relative to the nation's future sources of gas. GRA

N81-26599# Oak Ridge National Lab, Tenn. Information Div

DEPARTMENT OF ENERGY FOSSIL ENERGY ENVIRONMENTAL COMPLIANCE PROGRAM HANDBOOK FEDERAL REGULATIONS ON WASTE DISPOSAL

J Huffstetler, Bobbie Neal Collier, Kathy Brown (Tennessee Univ, Knoxville) and Nelda McAfee (Tennessee Univ, Knoxville) Feb 1981 373 p refs

(Contract W-7405-eng-26)

(ORNL/EIS-175) Avail NTIS HC A16/MF A01

The US Department of Energy (DOE) is conducting a research, development and demonstration program to provide technology that will permit rapid commercialization of processes for converting coal into synthetic fuels. This handbook identifies those federal laws and regulations on management of waste disposal that could affect the siting, construction or operation of a conversion facility. All entries are part of a computerized data base built and maintained for the DOE at Oak Ridge National Laboratory. DOE

N81-26615# Schwartz and Connolly, Inc, Washington, D C
AUTOMOBILE EMISSION IMPACTS OF GASOLINE USE

Jeffrey H Schwartz, Stephen J Connolly, E Joseph Duckett, Alexis J Hoskins, and Katharine W Kimball Oct 1980 107 p refs. Sponsored by National Alcohol Fuels Commission

(PB81-159394 NAFC-80-21) Avail NTIS HC A06/MF A01 CSCL 13B

Control options for evaporative emissions were examined in great detail. No major emission increases or decreases are foreseen as gasoline use increases. Any increases in ambient fuels of ozone (primarily due to increased evaporative hydrocarbon emissions with gasoline) are likely to be very small and develop gradually over the next 5-7 years. If these increases do occur, they are likely to be of concern only to those few regions still out of compliance with ambient ozone standards. The evidence to date suggests that gasoline marketing can continue without endangering public health and welfare. Policy options are explored for eliminating regulatory uncertainty surrounding this issue. GRA

N81-26884# Mound Lab, Miamisburg, Ohio

ASSESSMENT OF THE RADIOLOGICAL IMPACT OF COAL UTILIZATION 2. RADIONUCLIDES IN WESTERN COAL ASH

Clarence E Styron, Carl T Bishop, Vito R Casella, Philip H Jenkins, and William H Yanko 3 Apr 1981 177 p refs

(Contract DE-AC04-76DP-00053)

(MLM-2810) Avail NTIS HC A09/MF A01

The potential radiological impact of coal utilization is

investigated. A survey of western US coal mines and an assessment of emissions from a power plant burning Western coal were performed. Environmental deposition of radionuclides from stack emissions over a 20 year accumulation at a power plant burning Western coal was estimated to be 0.1 to 1.0% of measured background. An interlaboratory comparison of results of radioanalytical procedures, determining partitioning coefficients for radionuclides in bottom ash and fly ash, and an assessment of the potential for migration of radionuclides from ash disposal sites are made. Essentially all the nonvolatile radionuclides (uranium, radium and thorium) from feed coal are accounted for in fly ash and bottom ash. However, 20 to 50% of the volatile radionuclides (lead and polonium) from subbituminous and lignitic coals are not accounted for in ash, and it is assumed that this fraction exists via the stack. DOE

N81-26894# Harvard Univ, Cambridge, Mass. Energy and Environmental Policy Center

ALTERNATIVE INSTITUTIONAL ARRANGEMENTS FOR NUCLEAR POWER

D Bussard Aug 1980 8 p refs

(Contract DE-AC01-80PE-70278)

(DOE/PE-70278/T11) Avail NTIS HC A02/MF A01

An investigation of how alternative organizations of nuclear power generation would effect the regulatory environment for nuclear power production and how it would effect financial constraints on construction is discussed. The existence of governmental barriers to such reorganization are described. DOE

N81-27148*# Jet Propulsion Lab, California Inst of Tech, Pasadena

ELECTRICAL LOAD MANAGEMENT AT THE GOLDSTONE DSN COMPLEX

J C Rayburn *In its* The Telecommun and Data Acquisition Rept 15 Jun 1981 p 219-225

Avail NTIS HC A11/MF A01 CSCL 09C

A Power Load Management Plan was developed which utilizes the unique power generating capabilities of the stations to reduce the stress on the local utility's reserve capacity and reduce the cost of electrical power at the stations. The plan has greatly reduced the cost of Goldstone electrical power by completely eliminating the use of commercial power during the local utility's high usage periods each day. T M

N81-27600*# National Aeronautics and Space Administration, Washington, D C

GROWIAN 2 FOR MORE WIND POWER AND FIRST EUROPEAN SOLAR FARM INAUGURATED

Oct 1980 4 p. Transl into ENGLISH from Unschau in Wissenschaft und Techn (West Germany), v 80 no 15 1980 p 475-477. Transl by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-3198)

(NASA-TM-76177) Avail NTIS HC A02/MF A01 CSCL 10B

A wind power installation with a power of five megawatts to be used in the Federal Republic of Germany is described. The first European solar farm was inaugurated in Madrid and its operation is discussed. Author

N81-27621# Committee on Government Operations (U S House)

DEPARTMENT OF ENERGY'S EMERGENCY CONSERVATION PROGRAMS

Washington GPO 1980 203 p refs. Hearing before a Subcomm of the Comm on Govt Operations, 96th Congr, 2nd Sess., 4 Sep 1980.

(GPO-69-251) Avail Committee on Government Operations

The hearings focused on the Emergency Energy Conservation Act of 1979. The act provides for a procedure to develop a rationing plan. Conservation plans flexible enough to meet the needs of various State needs and practical enough to be rapidly implemented to meet national targets are discussed. T M

N81-27625# Systech Corp, Xenia, Ohio

TEST AND EVALUATION OF THE HEAT RECOVERY INCINERATOR SYSTEM AT NAVAL STATION, MAYPORT, FLORIDA Final Report, Jun 1980 - Apr 1981

01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

May 1981 169 p
(Contract N68305-80-C-0006)
(AD-A099559 CEL-CR-81 012) Avail NTIS
HC A08/MF A01 CSCL 13/2

This report describes test and evaluation of the two-ton/hr heat recovery incinerator (HRI) facility located at Mayport Naval Station, Fla., carried out during November and December 1980. The tests included (1) Solid Waste characterization, heating value and ultimate analysis, (2) Ash moisture combustibles, and heating values of both bottom and cyclone ashes. Extraction Procedure toxicity tests on leachates from both bottom and cyclone ashes trace metals in cyclone particulates, (3) Stack Emissions particulates (quantity and size distribution), chlorides, oxygen, carbon dioxide carbon monoxide, and trace elements and (4) Heat and Mass Balance all measurements required to carry out complete heat and mass balance calculations over the test period. The overall thermal efficiency of the HRI facility while operating at approximately 10 ton/hr was found to be 49% when the primary Btu equivalent of the electrical energy consumed during the test program was included. GEA

**N81-27629# Oak Ridge National Lab Tenn Energy Div
DISTRICT HEATING/COGENERATION APPLICATION
STUDIES FOR THE MINNEAPOLIS-ST PAUL AREA
IMPACT OF A DISTRICT HEATING/COGENERATION
SYSTEM ON ANNUAL AVERAGE SO₂ AIR QUALITY IN
THE TWIN CITIES**

M A Karnitz F C Konegay H A McLain B D Murphy R J Randon and E C Shlatter Mar 1981 109 p refs
(Contract W-7405-eng-26)
(ORNL-TM-6830/P11) Avail NTIS HC A06/MF A01

Annual average SO₂ concentrations in air at ground level were determined for a base year (1976) and for a future year (1987) with and without a 2600-MW(t) district heating system. Without district heating the SO₂ concentrations in the area are predicted to increase with time because of anticipated increased substitution of oil for curtailed natural gas. Implementation of the district heating/cogeneration system is predicted to mitigate this increase of SO₂ concentrations significantly. Although the total emissions will be slightly higher with district heating/cogeneration because of the substitution of coal for natural gas and oil use of tall stacks at the cogeneration plants will permit greater dispersion of the SO₂ emissions. Considerable overall energy savings, particularly in the form of natural gas and oil, will be realized with a district heating/cogeneration system. DOE

**N81-27632# Midwest Research Inst Golden, Colo Solar
Energy Research Inst
VALUE ANALYSIS OF WIND ENERGY SYSTEMS TO
ELECTRIC UTILITIES**

D Percival and Jim Harper Jan 1981 9 p refs Presented at the ASME Solar Energy Div 3rd Systems Simulation Econ Anal/Solar Heating and Cooling Operational Results Conf Reno, Nev., 27 Apr - 1 May 1981
(Contracts DE-AC02-77CH-00178 EG-77-C-01-4042)
(SERI/TP-732-1064) Avail NTIS HC A02/MF A01

The analysis is performed by a package of computer models that interface with most conventional utility planning models. Weather data are converted to wind turbine output powers which are used to modify the utility load representation. Execution of the utility planning models with both the original and modified load representation yields the gross and marginal value (\$/rated kW) of the added wind energy systems. This value is then compared with cost estimates to determine if for economic reasons the wind energy system should be included in future generation plans. DOE

**N81-27634# Oak Ridge National Lab Tenn Engineering
Physics Div
APPROACH TO EVALUATING ENERGY-ECONOMY MOD-
ELS**

C R Weisbin, R W Peele, and A S Leobl Mar 1981 76 p refs
(Contract W-7405-eng-26)
(ORNL-5742) Avail NTIS HC A05/MF A01

A set of guidelines was developed for evaluating energy economy models, the components of a thorough model evaluation are defined in an operational manner. Quantitative measures based on sensitivity and uncertainty analysis of results important to the user are included. Possible paths for future development of evaluation techniques are indicated, particularly those for which

evaluation components must be more strictly defined after further practical experience is gained. DOE

**N81-27644# Galaxy Inc Washington D C
STUDIES ON ADVANCED OVERSEAS ENERGY TECHNOL-
OGIES, VOLUME 1 Final Report**

R W Straus and J N Carsey Mar 1981 124 p refs
(Contract DE AC03-79SF-10538)
(DOE/SF-10538/T8-Vol-1) Avail NTIS HC A06/MF A01

A final evaluation is presented covering investigations over the past 5 years to perceive energy conversion technology and covering over 100 advanced energy technologies which saw many new developments in energy conversion in the countries studied. Specifically the state-of-the-art for specified technologies and the development of energy technologies overseas are discussed. The development of combustion technology in Sweden, Denmark, Finland, France, Netherlands, Italy, Spain, Portugal, Japan, Norway, and the Federal Republic of Germany is summarized. DOE

**N81-27660# Oak Ridge National Lab Tenn Energy Div
ENERGY-SAVING IMPACTS OF DOE'S CONSERVATION
AND SOLAR PROGRAMS (AN ORNL/MITRE STUDY
PERFORMED IN 1980) VOLUME 2 HISTORICAL TRENDS,
DETAILS OF SECTORAL ANALYSIS, AND APPENDICES**

R W Barnes J L Blue D M Boyd K R Corum R Gerstein, D L Greene D M Hamlin E Hirst, H Hoffman and G Kamp May 1981 491 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7690/V2) Avail NTIS HC A21/MF A01

Energy and oil impacts were estimated under a common set of assumptions concerning rising energy prices and economic growth. Historical trends in U.S. energy consumption, buildings and community systems, industry, transportation, solar energy storage systems and Energy Management Partnership Act are titles of sections presented. Information presented in the appendices includes existing energy legislation, research development and demonstration projects included in the OIP program analysis, regionalization of transportation sector inputs, national solar legislation and the Energy Management Partnership Act and related acts. DOE

**N81-27662# Midwest Research Inst Golden, Colo Solar
Energy Research Inst
COST OF ENERGY FROM SOME RENEWABLE AND
CONVENTIONAL TECHNOLOGIES, FY 1980 Progress
Report**

Apr 1981 114 p refs
(Contract DE-AC02-77CH-00178)
(SERI/SP-741-1022) Avail NTIS HC A06/MF A01

Up to date consistent and transparent estimates of the cost delivered energy from a selected number of solar and renewable technologies were developed and these were compared with the costs of conventional alternatives meeting the energy needs in comparable applications. Technology characterizations and cost assessments of representative systems relating to 23 solar and renewable resource technology/application pairs were performed. For each pair identical assessments were also made for representative conventional (e.g. fossil fuel) competing systems. The standardized methodology developed to do the technology characterizations and cost assessments is summarized. Assessments of technology/application pairs relating to distributed applications are presented, as well as central system assessments. DOE

**N81-27667# Oak Ridge National Lab Tenn
ACES FINAL PERFORMANCE REPORT Final Report,
1 Dec 1978 - 15 Sep 1980**

Van D Baxter Apr 1981 138 p refs
(Contract W-7405-eng-26)
(ORNL-CON-64) Avail NTIS HC A07/MF A01

The performance of the ACES in a single family residence near Knoxville, Tennessee was compared with that of two different air to air heat pumps in an identical house. Results show that energy was saved for the testing years. In addition to reducing consumption, the ACES significantly reduced integrated peak utility demands. Reinsulation of the ice storage bin reduced heat leakage rates by about 40 percent and resulted in increasing ground temperatures by an average of 5.60 C over first year levels.

The demonstration project and the ACES concept are described. Data acquisition procedures, system modifications, steady state performance, annual cycle performance, and effects of modifications are discussed. DOE

N81-27670# Public Technology Inc. Washington D C
DECISION PROCESS FOR THE RETROFIT OF MUNICIPAL BUILDINGS WITH SOLAR ENERGY SYSTEMS A TECHNICAL GUIDE

Nov 1980 212 p refs. Prepared in cooperation with the City of Los Angeles.

(Contract DE FG02 78IR-05106)

(DOE/IR 05106/2) Avail NTIS HC A10/MF A01

As a background for solar applications, the following topics are covered: solar systems and components for retrofit installations; cost performance and quality considerations; and financing alternatives for local government. The retrofit decision process is discussed as follows: pre-screening of buildings; building data requirements; the energy conservation audit; solar system sizing and economics; comparison of alternatives; and implementation. Sample studies are presented for the West Valley Animal Shelter and the Hollywood Police Station. DOE

N81-27682# Ruhrgas AG Essen (West Germany)

FUEL SAVINGS WITH CONVENTIONAL HOT WATER SPACE HEATING SYSTEMS BY INCORPORATING A NATURAL GAS POWERED HEAT PUMP. PRELIMINARY PROJECT DEVELOPMENT OF HEAT PUMP TECHNOLOGY. Final Report

Ludger vanHeyden and Erich Evertz. Bonn. Bundesministerium fuer Forschung und Technologie. Dec 1980. 227 p refs. In GERMAN ENGLISH summary. Sponsored by Bundesministerium fuer Forschung und Technologie.

(BMFT-FB-T-80-143 ISSN-0340-7608,

BMFT-03E5164A/ETS0004) Avail NTIS HC A11/MF A01

Compression type air/water heat pumps were developed for domestic heating systems rated at 20 to 150 kW. The heat pump is driven either by a reciprocating piston or rotary piston engine modified to operate on natural gas. Particular features of natural gas engines as prime movers, such as waste heat recovery and variable speed, are stressed. Two systems suitable for heat pump operation were selected from among five different mass produced car engines and were modified to incorporate reciprocating piston compressor pairs. The refrigerants used are R 12 and R 22. Test rig data transferred to field conditions show that the fuel consumption of conventional boilers can be reduced by 50% and more by the installation of engine driven heat pumps. Pilot heat pumps based on a 1 600 cc reciprocating piston engine were built for heating four two-family houses. Pilot pump operation confirms test rig findings. The service life of rotary piston and reciprocating piston engines was investigated. The tests reveal characteristic curves for reciprocating piston engines and include exhaust composition measurements. Author (ESA)

N81-27684# Volkswagen AG Wolfsburg (West Germany)
 Forschung und Entwicklung

FUEL CONSERVATION IN CONVENTIONAL HOT WATER HEATING SYSTEMS BY INCORPORATING A GAS ORIENTED HEAT PUMP. DEVELOPMENT OF A HYBRID PISTON PUMP/PISTON ENGINE. Final Report

Juergen Pohle and Bernd Wiedemann. Bonn. Bundesministerium fuer Forschung und Technologie. Dec 1980. 176 p refs. In GERMAN ENGLISH summary. Sponsored by Bundesministerium fuer Forschung und Technologie.

(BMFT-FB-T-80-152 ISSN-0340-7608,

BMFT-03E5165F/ETS00041) Avail NTIS HC A09/MF A01

The possibility of reducing energy consumption 50% by utilizing an internal combustion engine, driving a heat pump connected to a conventional central heating system is shown. Taking standard engines from motor vehicle production lines, then modifying them to run on natural gas, complete prototype heat pump systems with infrequent maintenance requirements and prolonged life were developed. The main feature of the modified engine design is that part of the block is used as a compressor for the pump. The manufacture of the engine is only practical if it is possible to reduce production costs to below that of existing compact units. Extensive field tests are recommended in order to prove the economy of the system. Author (ESA)

N81-27686# National Bureau of Standards, Washington D C
 Center for Building Technology

ENERGY ANALYSIS OF A PROTOTYPE SINGLE-FAMILY DETACHED RESIDENCE. THE EFFECTS OF CLIMATE, HOUSE SIZE, ORIENTATION, INTERNAL HEAT RELEASE, AND NATURAL COOLING

James P Barnett. Jan 1981. 47 p refs. Sponsored in part by DOE.

(PB81-166514, NBSIR-80-2184)

Avail NTIS

HC A03/MF A01 CSCL 10A

A computer study was done to determine how the annual heating and cooling requirements of a prototypical ranch-style house are affected by changes in four energy use parameters: climate, floor area, orientation, and internal heat generation. The effects of natural cooling on the annual cooling requirements were also investigated. GRA

N81-27689# Transportation Research Board, Washington D C
TRANSPORTATION ENERGY DATA, FORECASTING, POLICY, AND MODELS

Michael Morris, Antti Talvitie, David T Hartgen, Nathan S Fribbaum, Martin E H Lee, Matthew F Glover, Donald A Maxwell, Dennis V Williamson, Nancy S Dorfman, and Ian E Harrington. 1980. 118 p refs.

(PB81-172579, TRB/TRR-764 ISBN-0-309-03107-9,

ISSN-0361-1981 LC-81-1665) Avail NTIS HC A06/MF A01

Paper Copy also avail. Transportation Res Board, 2101 Constitution Ave NW, Washington, D C 20418. CSCL 10A

The 16 papers in this report deal with the following: assessment of energy and petroleum consumption of different transportation modes in the Buffalo area; long range forecasts of transportation energy consumption in New York state; use of disaggregate data to evaluate gasoline conservation policies; evaluating the costs and benefits of plans to reduce gasoline queues; review of analytical models of gasoline demand during an energy emergency; direct energy accounts for urban transportation planning; transportation energy effects on urban growth; travel demand and estimation of energy consumption by a constrained model; and transportation system management actions: a study of the energy costs. GRA

N81-27693# Committee on Science and Technology (U S House)

OVERSIGHT ENVIRONMENTAL IMPACT STATEMENT
 Washington GPO. 1980. 237 p refs. Hearing before the Subcomm on Energy Develop and Applications of the Comm on Sci and Technol, 96th Congr, 2nd Sess. No 156. 19 Sep 1980.

(GPO-69-196) Avail Subcommittee on Energy Development and Applications

The need for greater cooperation between the EPA and DOE and clarification of policies regarding the environmental review process for major synthetic fuel demonstration projects are considered. The costs of various pilot projects and budgetary increases to be faced because of delays are examined. A R H

N81-27699# Department of Energy, Bartlesville Okla
ENVIRONMENTAL, RESOURCE CONSERVATION, AND ECONOMIC ASPECTS OF USED OIL RECYCLING

D W Brinkman, M L Whisman (Waste Oil Consulting), N J Weinstein (RECON Systems, Inc), and H R Emmerson (Petroleum Technology Energy Resources). Apr 1981. 62 p refs.

(DOE/BETC-RI-80/11) Avail NTIS HC A04/MF A01

In order to provide current and updated information, the case for burning used automotive lubricating oil versus re-refining was reevaluated based upon the 1980 American economy and energy conservation posture. In these comparisons, the environment is considered within four scenarios ranging from unrestricted burning of used oil without government constraints to complete prohibition of burning thereby funneling all used automotive lube oils to re-refining. The material and energy advantages to be realized in terms of resource conservation through either burning or re-refining, and an estimation of the economics and profit potential currently available in the disposition of used lube oil were examined. It is found that environmental concerns as presently regulated do not alone provide a persuasive case for re-refining over burning of used automotive lubricating oil. DOE

N81-27702# Argonne National Lab, Ill
Energy and Environmental Systems Div

SHORT-TERM NITROGEN DIOXIDE MODELING CURRENTLY AVAILABLE MODELS AND THE APPLICATIONS AND DEVELOPMENT NEEDED FOR ENERGY ASSESSMENT

K C Chun Nov 1980 39 p refs
(Contract W-31-109-eng-38)

(ANL/EES/TM-132) Avail NTIS HC A03/MF A01

Multiple interdependent factors that affect local short term concentrations of nitrogen dioxide such as meteorology air quality and the characteristics and distribution of emission sources of nitrogen dioxide precursors are discussed. The utility and limitations of existing air quality models for nitrogen dioxide including empirical mechanistic and empirico-mechanistic models are evaluated. An approach for applying and developing relatively simple models for predicting short term concentrations of nitrogen dioxide in assessments of regional and national energy development are suggested. E D K

N81-27705# WESTEC Services, Inc., Albuquerque, N Mex BACA GEOTHERMAL DEMONSTRATION PROJECT BASELINE ECOSYSTEM STUDIES OF COOLING TOWER EMISSION EFFECTS Interim Report

P Leitner, R Osterling, D Price, and J Westermeyer Mar 1981 30 p Sponsored in part by Union Geothermal Company of New Mexico Prepared for Public Service Company of New Mexico

(Contract DE-FC03-78ET-27163)

(DOE/ET-27163/6) Avail NTIS HC A03/MF A01

Results of baseline studies for boron arsenic mercury and fluorine in vegetation and soil near the Baca Geothermal Demonstration Power Plant are provided for the 1980 sampling season. Preliminary results of visual vegetation assessments and population density studies of soil invertebrate fauna are also provided. Boron arsenic mercury and fluorine levels in concentrations of soil arsenic and mercury were comparable to foliage concentrations. Boron concentrations were lower in soil than in foliage, whereas soil fluorine concentrations were considerably higher than foliage concentrations. With the exception of heavy insect infestations in June-July, no vegetation abnormalities were noted. Preliminary soil invertebrate analysis indicated an overall arthropod density of approximately 100,000/m² which appears within the normal range encountered in forest and meadow soil. DOE

N81-27789# Argonne National Lab Ill HEALTH EFFECTS OF SYN FUELS TECHNOLOGY A REVIEW

L P Sanathanan C A Reilly S A Marshall and K E Wilzbach Apr 1981 65 p refs

(Contract W-31-109-eng-38)

(ANL/ES-111) Avail NTIS HC A04/MF A01

Annotated synopses of information pertinent to health impacts of synthetic fuel technologies under development are presented. The focus is on carcinogenesis which appears to be a special problem with coal conversion technologies. This review is intended to serve as a reference for the NEPA Affairs Division of DOE in its evaluation of the overall synthetic fuel program and specific projects in the program. DOE

N81-27793# Naval Medical Research Inst Wright-Patterson AFB Ohio Toxicology Detachment**THE TOXICITY OF GRADE JP-5 AVIATION TURBINE FUEL, A COMPARISON BETWEEN PETROLEUM AND SHALE-DERIVED FUELS**

Morris J Cowan Jr and Lawrence J Jenkins, Jr (Shell Development Co Houston, Tex) In AGARD Toxic Hazards in Aviation Apr 1981 7 p refs

Avail NTIS HC A07/MF A01

In order to assess the suitability of shale-derived JP-5, it is important that its inherent toxicity be identified and that the comparative toxicity of both the shale and petroleum JP-5 be identified. As a liquid acute spill hazard the fuels were examined for ocular and dermal irritation potential and for skin sensitization potential. Since the fuel is a complex mixture of aliphatic and aromatic hydrocarbons each exhibiting different vapor pressures the nature of any accidental inhalation exposure will be dependent on the concentration of low boiling components in the mixture. The fuels were examined as a vapor inhalation hazard by exposing animals continuously for 90 days to vapors as high as 750 mg/cu m. Groups of animals were examined at 90 days and at the end of their normal expected lifetime. The

fuels were examined as a potential oncogen by histopathologic examination of the animals exposed for 90 days and held for a lifetime. T M

N81-27797# Ohio State Univ Columbus Dept of Veterinary Pathobiology**INHIBITION OF VIRUS TRANSFORMATION BY HIGH ENERGY FUELS AS A CORRELATE OF CARINOGENIC POTENTIAL**

James R Blakeslee, Jr In AGARD Toxic Hazards in Aviation Apr 1981 6 p refs

(Contracts F49620-77-C-0110 F49620-C-0087)

Avail NTIS HC A07/MF A01

Hydrazine and naphthylamines and their derivatives were assayed for co-carcinogenic effects on ST FeSV-directed transformation of human cells. All chemicals tested at non-toxic concentrations showed anti-carcinogenic activity. The temporal relationship of chemical treatment to virus infection was more critical with the hydrazines than with the naphthylamines in that maximum anti-carcinogenic effect occurred when virus-infected cells were exposed to the hydrazines 2 hrs post-infection whereas the naphthylamines anti-carcinogenic effect was observed if cells were exposed either pre- or post-infection. The anti-carcinogenic effect, when compared with in vitro chemical transformation and neoplastic transformation show a high degree of correlation. These data suggest this assay system may lend itself to a rapid screen (9-13 days) of chemicals for carcinogenic potential. Cytotoxic results showed no significant difference in shale oil or petroleum derived JP5 or DFM. Author

N81-27901# Du Pont de Nemours (E I) and Co Aiken SC ALTERNATIVES FOR LONG-TERM MANAGEMENT OF TRANSURANIC WASTE AT THE SAVANNAH RIVER PLANT

O A Towler Jr and G F Molen 1981 16 p refs Presented at the Waste Management Symp Tucson Ariz 23-26 Feb 1981 Submitted for publication

(Contract DE-AC09-76SR-00001)

(DP-MS-80-77) Avail NTIS HC A02/MF A01

The six alternatives are proposed which consider the effects of making no decision (alternative 1) delaying a decision for up to 100 years (alternatives 2 and 3) or taking significant action (alternatives 4 5 or 6). Alternative 4 exhibits intermediate cost and risk values and indicates good agreement with ideal disposal characteristics. Alternative 6, which is comparable to alternative 4 in risk and disposal characteristics would require a large single outlay of capital funds whereas funds for alternative 4 could be staged. The cases described excluding the no action case represent the better alternatives of the 34 that were studied. Their costs range from 80 to 270 million dollars while the sum of the population risk and worker dose ranges from 95 to 13 800 man-rem. The naturally occurring dose from cosmic rays and terrestrial activity to the same population over the same period is many times larger. DOE

N81-27988# Oak Ridge National Lab Tenn Energy Div TRANSPORTATION ENERGY REQUIREMENTS TO THE YEAR 2010

Garland Samuels Apr 1981 97 p refs

(Contract W-7405-eng-26)

(ORNL-5745) Avail NTIS HC A05/MF A01

The potential reduction in energy use in the transportation sector through the year 2010 is studied in the context of a strong national policy of conservation. Projections are made for efficiency improvements and demand growth for each transportation mode and future energy requirements are derived. Electric vehicles are projected to be limited to short-range (< 150 km) applications. Although battery technology will probably advance to the point that longer-range (200 to 300 km) vehicles are practical, the additional weight and cost of the batteries will probably offset any energy or cost advantage for these vehicles. If coal becomes the primary fuel used there appears to be little if any energy savings from using electricity as compared to converting the coal to synthetic liquid fuels. DOE

SOLAR ENERGY

Includes solar collectors solar cells solar heating and cooling systems, and solar generators

A81-30593 # Climatological studies of solar radiation and the utilization of such studies in solar energy technology (Klimatologicheski e issledovaniia rezhima solnechnoi radiatsii dlia ispol'zovaniia ikh v geliotekhnicheskikh tseliakh). T G Berliand In *Radiation factors of climate* Leningrad, Gidrometeorizdat, 1980, p 3-35 63 refs In Russian

Studies on the monitoring of solar radiation are surveyed. The year-long operation of solar energy systems under clear-sky conditions for a given level of solar radiation intensity is investigated, and data on sunshine hours for various climatological regions of the USSR are reviewed. Finally, problems associated with the rational utilization of solar radiation as a source of renewable energy are formulated. B J

A81-30640 # Cascade solar arrays based on silicon and germanium matrix solar cells (Kaskadnye fotogeneratory na osnove kremnievykh i germanievykh matrichnykh fotopreobrazovatelei) D S Strebkov, V A Tikhomirova, and G B Fedosova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istoknikov Toka, Moscow, USSR) *Geliotekhnika*, no 1, 1981, p 21-23 In Russian

The construction of a cascade solar array based on silicon and germanium matrix-type solar cells is reported. Arrays were connected in parallel according to the criterion of equal operating voltages under optimal loads in each stage, and in series according to the criterion of the equality of operating currents, based on measurements of the volt-ampere characteristics of the devices. Measured photocurrents produced under illumination by a tungsten lamp at an irradiance of 0.1 W/sq cm indicate improvements in efficiency relative to the most efficient single material (silicon) amounting to 2% for the germanium irradiated through silicon, and 35-40% for germanium irradiated directly. It is pointed out that the present devices may be useful as photocells with a wide band of spectral sensitivity. A L W

A81-30641 # The effect of nonuniform fluid flow distribution in a system of solar collectors on thermal output (Vliianie neravnomernosti raspredeleniia potoka zhidkosti v sisteme solnechnykh kollektorov na vyrabotku tepla) S I Smirnov, Iu A Konstantinovskii, and A S Torshin (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) *Geliotekhnika*, no 1, 1981, p 24-28 In Russian

Consideration is given to the effects of a nonuniform distribution of the heat carrying fluid flow rates in an array of identical solar collectors connected in parallel on the heat output of the array. An expression is derived for the factor by which total heat output in uniform flow differs from that in nonuniform conditions in terms of water inflow and outflow rates from the separate collectors. Calculations show that for a given flow rate through the array, heat output decreases with increasing flow nonuniformity, however significant decreases in output are only produced at very large flow nonuniformities. Results are presented of experimental measurements of heat output from an array of ten parallel branches containing four collectors each and operating at different flow rates which confirm the theoretical results. A L W

A81-30642 # Combined solar energy converters with selective coatings (Kombinirovannye preobrazovately solnechnoi energii s selektivnymi pokrytiiami) M M Koltun (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istoknikov Toka, Moscow, USSR) *Geliotekhnika*, no 1, 1981, p 54-60 25 refs In Russian

The role of selective optical coatings in increasing the efficiency of combined solar energy converters, which may consist of two or more devices operating on the same physical principle in different spectral regions, or two energy conversion devices based on different principles, is discussed. Consideration is given to uses of specially designed selective coatings to improve the efficiencies of cascade solar cells, photovoltaic/thermal solar energy converters, which

produce both heat and electricity simultaneously, and thermophotovoltaic electric converters, which transform thermal radiation into electrical energy using narrowband semiconductors. It is concluded that, partly due to the use of selective coatings, combined solar energy converters appear to be the most suitable for future solar energy research. A L W.

A81-30643 # Evaluation of the effectiveness of using selective surfaces in solar thermal collectors (Otsenka effektivnosti ispol'zovaniia selektivnykh poverkhnostei v teplovykh geliopriemnykh). R. A Zakhidov, A Abdurakhmanov, and Sh I. Klychev (Akademiia Nauk Uzbekskoi SSR, Spetsial'noe Proektno-Konstruktorskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *Geliotekhnika*, no 1, 1981, p 61-66 In Russian

A81-30651 Photovoltaic solar energy conversion in the '80s (La conversion photovoltaïque de l'énergie solaire dans les années 80). I Chevalier (Commissariat à l'Energie Solaire, Paris, France) *Revue de l'Energie*, vol 32, Mar-Apr 1981, p 131-133 In French

The potential for photovoltaic solar energy conversion in the generation of electricity to meet the needs of industrial and developing nations in the 1980s is discussed. The current technology of photovoltaic cells and modules, which are for the most part based on single crystal silicon and can deliver peak powers of 2 to 40 W at 6 to 12 V, is reviewed and prospects for cost reduction in the short- and medium-term by the development of new materials and production methods and increased cell efficiency and in the long term by the development of thin film cells, alternative compounds and mass production are indicated. Possible applications of photovoltaic derived electricity are pointed out, including educational television receivers, rural telephones, refrigerators, water pumping and hospitals in developing nations and telecommunications, cathodic protection, signaling, telemetry and low-power pumping applications in industrial nations. Predictions of a photovoltaic peak Watt installed costing less than 10 francs by 1990 and a market above 100 MW in 1985 are pointed out. A L W

A81-30690 The influence of temporal variations in illumination on solar photoreactor operation - Theoretical study (Influence des variations temporelles d'éclairement sur le fonctionnement d'un photoréacteur solaire - Etude théorique) F Duprat and J L Chevalier (Aix-Marseille, Université, Marseille, France) *Entropie*, vol 16, no 94, 1980, p 74-80 6 refs In French

A method is presented for calculating reactant concentrations in a solar photochemical reactor illuminated by variable intensities of solar radiation. Equations are derived for reactant concentration profiles along the length of a continuous flow tubular reactor on the axis of a truncated conical solar reflector, within which a reaction occurs which follows first order kinetics with respect to incident luminous intensity and reactant concentration. Concentrations produced by linearly and sinusoidally varying solar irradiation levels resulting in the same total solar energy input are compared, and it is found that the reactant concentration at the exit on the reactor does not depend on the distribution of light intensity or the energy received by the reactor separately, but rather on the Damkohler number, which is the product of the mean intensity received by the reactant during its residence in the reactor with the velocity constant and transit time, and on reactor optical density. A L W

A81-30999 Limitations on the open-circuit voltage imposed by P+/ and N+/ regions in silicon solar cells. M A Shibib and J G Fossum (Florida, University, Gainesville, Fla.) *Journal of Applied Physics*, vol 52, Feb 1981, p 1072-1075 16 refs. Research supported by the U S Department of Energy

It is shown theoretically and experimentally that the emitter recombination current, which limits the open-circuit voltage of silicon solar cells, can be more easily suppressed in P(+)/N cells than in N(+)/P cells. This result is due to fundamental effects that occur in heavily doped silicon: degeneracy of the majority charge carriers, Auger recombination, and energy-band-gap narrowing. Cell designs to suppress the emitter current are discussed, and experimental data supporting our theoretical analysis are presented. (Author)

A81-31000 Silicon solar cells realized by laser induced diffusion of vacuum deposited dopants. E Fogarassy, R Stuck, J J

Grob, and P Siffert (CNRS, Centre de Recherches Nucleaires de Strasbourg, Strasbourg, France) *Journal of Applied Physics*, vol 52, Feb 1981, p 1076-1082 25 refs

A technique for solar cell preparation based on vacuum deposition of thin films of dopants on silicon, followed by irradiation with a high energy (roughly 1.5 J/sq cm) ruby laser pulse is described. Several dopants like phosphorus, antimony, bismuth, aluminium, gallium, and indium have been investigated. Electrical and Rutherford backscattering measurements indicate that the dopant is dissolved in the silicon and becomes electrically active as a result of the irradiation. The p-n junctions which are formed are shallow (depth less than 4000 Å) but heavily doped, since after the laser treatment the solubility of the dopant is generally higher than after a thermal diffusion. Therefore good diode characteristics can be achieved by this simple method, and solar cells up to 14 percent efficiency under AM1 (air mass 1) illumination have been realized using dopants like phosphorus, antimony, bismuth, aluminium, or gallium (Author)

A81-31003 Effect of band gap narrowing on the built-in electric field in n-type silicon J Geist and J R Lowney (National Bureau of Standards, Washington, D C) *Journal of Applied Physics*, vol 52, Feb 1981, p 1121-1123 5 refs

A relation is derived to describe the change in the built-in electric field in an n-type semiconductor due to band tailing and carrier freeze out, as well as band gap narrowing. Recent numerical models of these various phenomena were used to illustrate the effect on heavily doped n-type silicon. While neither band-gap narrowing, band tailing, nor deionization alone is sufficient to explain the large decrease in the built-in electric field that has been inferred from experimental measurements, the combination of all three effects may be sufficient (Author)

A81-31198 Maximum conversion efficiency for the utilization of direct solar radiation S M Jeter (Georgia Institute of Technology, Atlanta, Ga) *Solar Energy*, vol 26, no 3, 1981, p 231-236 9 refs

The thermodynamic properties of the direct component radiation are considered, and the concept of essergy (the potential work of a system) and availability in steady flow are employed in the ideal-work determination. The maximum efficiency for the continuous conversion of extraterrestrial radiation to work is given by the Carnot efficiency. The emission and propagation of solar energy is shown to be equivalent to a heat interaction with a thermal energy reservoir at the solar temperature. The essergy of the resultant radiation at the earth's orbit, the extraterrestrial solar radiation (ESR), is equivalent to the essergy of heat. A formula for the maximum conversion efficiency for a system with ESR as its input is given (K S)

A81-31199 On non-linear effects in flat-plate collector efficiency curves J M Gordon (Negev, University, Sede Boqer, Israel) *Solar Energy*, vol 26, no 3, 1981, p 265, 267 Research supported by the Ministry for Immigrant Absorption of Israel

A81-31200 Linear efficiency characterisation for high temperature flat plate collectors R Gani (Monash University, Clayton, Victoria, Australia), D Proctor, and J G Symons (Commonwealth Scientific and Industrial Research Organization, Div of Mechanical Engineering, Highett, Victoria, Australia) *Solar Energy*, vol 26, no 3, 1981, p 271-273 9 refs

The efficiency characteristic of most flat-plate collectors shows significant curvature, which becomes more pronounced at higher fluid temperatures. Most collectors also show an additional dependence on the insolation level. A re-examination of the original justification for linear and second order efficiency characteristic is presented. It shows that for flat-plate collectors a linear form of efficiency characteristic can be generated, which will have greater applicability in system simulation studies. This may also be applied to methods interpreting test results for collectors (K S)

A81-31244 Modeling of solid state materials for solar cells *Energy and Technology Review*, Apr 1981, p 11-21 10 refs Research sponsored by the Solar Energy Research Institute

A computer model has been developed for calculating the

complex energy band structure and wave vector of semiconducting materials for solar cell applications, and for evaluating the performance of solar cells. Material parameters, i.e., the absorption coefficient, the carrier mobility, and the carrier lifetime, were determined by performing a complex integration, and candidate materials, such as CdSiAs_2 , BaS , ZnSiAs_2 , Zn_3P_2 , and ZnSnP_2 , have been investigated theoretically. The adjustable parameters of solar cell design, i.e., doping, geometry, resistivity, intersurface and surface recombination velocities, and grain size have also been evaluated to determine the solar-cell efficiency. Theoretical characteristics of a cadmium-silicon-arsenide homojunction solar cell are presented with the results accurate enough to enable a quick and low priced evaluation of potential solar cell materials (K S)

A81-31393 Structural analysis of large hexagonal compression frame/tension cable array structure for SPS microwave antenna H S Greenberg (Rockwell International Corp., Space Operations and Satellite Systems Div., Seal Beach, Calif) *Society of Allied Weight Engineers, Annual Conference, 39th, St Louis, Mo, May 12-14, 1980, Paper 1373* 25 p

A structural analysis is presented for the large aperture diameter Microwave Power Transmission System (MPTS) antenna required by prospective Satellite Power Systems. Requirements for this orbital structure are severe, with aperture diameters of between 1 and 2 km and the maintenance of array surface flatness from $1/8$ to $1/2$ m. The proposed structure is composed of an orthogonal array of cables, stabilized by a peripheral compression carrying frame that provides the primary structural support system. The critical structural requirements, load stability criteria, and parametric load/deflection analysis methodology are described (O C)

A81-31510 Dynamic simulation and parametric sensitivity studies on a flat-plate solar collector D Wolf, A I Kudish, and A N Sembira (Negev, University, Beersheba, Israel) *Energy* (UK), vol 6, Apr 1981, p 333-349 10 refs

A dynamic simulation program for a flat plate solar collector has been developed and used for a parametric sensitivity study of the collector. A computer simulation language, CSMP, was used for the simultaneous solution of the differential equations describing the system. The program is developed from basic principles and defined parameters, so that the effect of each element of the collector on its efficiency and outlet fluid temperature can be analyzed. The dynamic simulation program was validated by comparing calculated with actual test results on a commercial flat plate solar collector, the agreement between the results was found to be very good. Sensitivity studies were carried out to determine the effect of the following parameters on the performance of a single-glazed solar collector: heat transfer coefficient between absorber plate and fluid transport tubes, fluid flow rate through the collector, plate absorptivity, plate emissivity and insulation thickness. Sensitivity studies were also performed on a double-glazed solar collector but for only the last three of the above parameters. The transient behavior of the solar collector, viz the response of the outlet fluid temperature to a step change in insolation rate, has also been studied (Author)

A81-31511 On the development of the salt concentration profile in a solar pond A Akbarzadeh and G Ahmadi (Shiraz, University, Shiraz, Iran) *Energy* (UK), vol 6, Apr 1981, p 369-382 18 refs Research supported by the University of Shiraz, Ministry of Education and Higher Education, and Ministry of Power of Iran

The problem of the development of the salt concentration profiles in a solar pond is investigated. Three different types of boundary conditions are considered and exact solutions for the salt concentrations as functions of space and time are obtained and discussed. The effect of wind velocity and size of the pond on the effective mass diffusivity of salt is studied. Several examples of the development of the salt concentration profiles for various wind speeds and pond sizes are considered and the results are plotted and discussed. The time variations of salt fluxes and consumptions are also presented for some cases (Author)

A81-31685 A Schottky barrier type solar cell using polyacetylene J Tsukamoto, H Ohgashi (Toray Industries, Inc., Kamakura, Kanagawa, Japan), K Matsumura, and A Takahashi (Toray Industries, Inc., Otsu, Shiga, Japan) *Japanese Journal of Applied Physics*, vol 20, Feb 1981, p L127-L129 8 refs

Schottky barrier type solar cells are fabricated using polyacetylene, (CH)_x, as the semiconductive material. Under illumination from a tungsten lamp source (approximately 40 mW/sq cm), a short circuit voltage of approximately 0.4 V, an open circuit current of approximately 40 microamperes/sq cm, and a fill factor of approximately 0.25 are obtained. The energy conversion efficiency is estimated to be 0.2% in relation to the energy absorbed within the depletion region. C R

A81-31914 # Survey of power tower technology A F Hildebrandt and S Dasgupta (Houston, University, Houston, Tex.) *ASME, Transactions, Journal of Solar Energy Engineering*, vol 102, May 1980, p 91-104 38 refs

The history of the power tower programs is reviewed and attention is given to the current state of heliostat, receiver, and storage design. Economic considerations are discussed, as are simulation studies and implications. Also dealt with are alternate applications for the power tower and some financing and energy aspects of solar electric conversion. It is noted that with a national commitment to solar energy, the power tower concept could generate 40 GW of electricity and double this amount in process heat by the year 2000. Calculations show an energy amplification factor of 20 for solar energy plants, that is, the ratio of the electric energy produced over the lifetime of a power plant to the thermal energy required to produce the plant. C R

A81-31915 # Systems analysis of a solar industrial process steam generating plant G D Gupta, A C Gangadharan, and G K Bhayana (Foster Wheeler Development Corp., Livingston, N J.) *ASME, Transactions, Journal of Solar Energy Engineering*, vol 102, May 1980, p 105-111

The systems analysis of a solar steam production plant designed to generate industrial process steam at 1034 kPag is presented. The project is intended to develop a demonstration unit with 929 sq m of solar collector surface area. An economic model has been developed for use in the systems analysis of solar steam plants. The economic model uses the annualized cost of a unit of fossil energy displaced by the solar steam plant as the cost-effectiveness parameter. The different factors that must be taken into account in developing this cost effectiveness parameter are discussed. The concept selected for the detailed systems analysis uses an intermediate heat-transfer fluid in the primary loop. This fluid is circulated through the solar collectors to a boiler where steam is generated. Parabolic trough collectors are used in the system. (Author)

A81-31916 # Solar heating and cooling system efficiency as a function of design and installation D S Ward (Colorado State University, Fort Collins, Colo.) *ASME, Transactions, Journal of Solar Energy Engineering*, vol 102, May 1980, p 158-165 12 refs

The effects of design and installation features on the overall efficiency of solar heating and cooling systems are evaluated. Solar system piping and thermal storage heat losses and parasitic power requirements are quantitatively evaluated by considering different degrees of insulation and design configurations. It is demonstrated that these system variables have a very strong effect on the technical feasibility of solar heating and/or cooling systems. (Author)

A81-31917 # Survey of solar materials B L Butler (Solar Energy Research Institute, Golden, Colo.) and R S Claassen (Sandia Laboratories, Albuquerque, N Mex.) *ASME, Transactions, Journal of Solar Energy Engineering*, vol 102, Aug 1980, p 175-187 39 refs. Contracts No DE-AC04-76DP 00789, No EG 77 C-01 4042

Attention is given to the research and development being carried out on the materials for solar technology. A general framework in which materials development can be considered is given. It starts with emphasis on performance, life, and cost and ends with a recommendation for systems studies before expending effort on materials development. The properties of selected solar absorber surfaces are presented, as are thermal and optical properties of cover plate materials and specular reflectance properties of several mirror materials. Materials are also discussed in the context of conversion processes, among them thermal processes and quantum processes. C R

A81-31918 # Low cost solar selective chromate conversion coatings applied to stainless steel substrates J R Culham and P

Niessen (Waterloo, University, Waterloo, Ontario, Canada) *ASME Transactions, Journal of Solar Energy Engineering*, vol 102, Aug 1980, p 188-191 9 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada

Solar selective surfaces have been produced on austenitic and ferritic stainless steels using an acidic chromate bath at 75 C. These surfaces have been shown to have high humidity resistance and good thermal stability. The conversion coatings can be applied uniformly over large surfaces, even surfaces of nonplanar topography. Complete sets of plating parameters for different grades of stainless steels are presented which may be used for the implementation of this process for the production of low grade heat collecting systems. (Author)

A81-31937 Influence of the electric field on collection efficiencies of solar cells K W Boer (Delaware, University, SES, Inc., Newark, Del.) *Applied Physics Letters*, vol 38, Apr 1, 1981, p 537-539 13 refs. Research supported by the U S Department of Energy

It has been observed that solar cells that show a field dependent collection efficiency in the current saturation range exhibit a field dependent carrier redistribution over localized states within the junction. It is suggested here that such a redistribution may be caused by field quenching (a well known effect in photoconductive CdS) which provides for field saturation and causes the short-circuit current to saturate before the emitter limit is reached. B J

A81-31945 Efficient solar to chemical conversion - 12% efficient photoassisted electrolysis in the (p-type InP/Ru)/HCl-KCl/Pt/Rh cell A Heller and R G Vadimsky (Bell Telephone Laboratories, Inc., Murray Hill, N J.) *Physical Review Letters*, vol 46, Apr 27, 1981, p 1153-1156 36 refs

A81-32137 A tandem photovoltaic cell using a thin-film polymer electrolyte T Skotheim (CNRS, Laboratoire d'Electrochimie Interfaciale, Meudon, Hauts-de-Seine, France) *Applied Physics Letters*, vol 38, May 1, 1981, p 712-714 17 refs

A photovoltaic cell has been demonstrated where a polymer electrolyte (polyethylene oxide with a polysulfide redox couple) in the form of a thin solid film is used to connect in optical and electrical series an n-type CdS thin film and a p-type CdTe single crystal. The open circuit voltage using a 100 mW/sq cm xenon light is 625 mV, rising to 850 mV with a concentration factor of about 2. The dark voltage is as high as 170 mV and short-circuit currents are 20-35 microamperes/sq cm. V L

A81-32156 # Optimizing operation of solar brine regenerator-heaters (Optimizatsiya raboty solnechnykh regeneratov-nagrevatelei rastvora) V A Baum, A D Khandurdyev, and A D Kakabaez (Turkmenstii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR) *Akademiia Nauk Turkmenstko SSR, Izvestiia, Seriya Fiziko Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no 2, 1981, p 21-25. In Russian

The energy characteristics of solar regenerator heaters used in a combined cooling and hot water supply system are studied by using the exergetic method of thermodynamic analysis. The analysis yields expressions for the operating temperature that would provide the maximum specific exergy of a regenerator heater. V L

A81-32284 The linear RF repeater J W Oades (GTE Lenkurt, Inc., San Carlos, Calif.) In ICC '80, International Conference on Communications, Seattle, Wash., June 8-12, 1980, Conference Record Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p 621-625

The purpose of a microwave repeater is to receive, amplify, and redirect microwave signals. The repeater described in this paper does this with a minimum of circuitry and support hardware. There is no frequency translation in the repeater which is made up of amplifiers and filters. There are no oscillators, modulators and no requirements for special environmental conditioning resulting in a repeater with low power requirements which can normally be supplied by solar photovoltaic cells. Only linear processes are used and the repeater can transmit any modulation format currently used in terrestrial microwave networks. This paper describes the repeater circuitry, the characteristics of the amplifier, and the effects of antenna to antenna

coupling on performance. Experience with operational installations is described and future applications are discussed (Author)

A81-32285 The potential of solar powered radio relay stations P Antonucci In ICC '80, International Conference on Communications, Seattle, Wash., June 8-12, 1980, Conference Record Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 631-636 5 refs

The paper examines the principles behind the design of radio repeater equipment in such a way as to exploit solar power and energy conservation concepts, this makes possible the realization of a self-contained cost-optimized integrated system with appealing features from the viewpoint of versatility of installation and reliability. As extreme examples of solar power applications, this paper describes two types of relay stations: (1) a two way hot standby link with a capacity of up to 960 channels utilized at more than 100 sites, and requiring just 30 W of primary power, and (2) a two way station with a capacity of 1800 channels, in triple diversity, and requiring 900 W of primary power B J

A81-32286 Solar-powered microwave radio relay system. H Yokouchi, H Masuda, T Oguchi (Fujitsu, Ltd., Kawasaki, Japan), and H Komizo (Fujitsu Laboratories, Ltd., Kawasaki, Japan). In ICC '80, International Conference on Communications, Seattle, Wash., June 8-12, 1980, Conference Record Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 641-645

Microwave repeater stations that use solar battery power systems and low power consumption can considerably decrease initial and operating costs of radio relay systems. In addition, the reduction of the power consumption of radio equipment improves maintainability and makes operating environment ranges wider. The principal new techniques applied to this radio equipment are five volt supply voltage for the circuit (except the microwave power amplifiers), high-efficiency FET microwave power amplifiers, and highly stable dielectric resonator local oscillators B J

A81-32402 Solar-electrics research and development R L Bailey (Florida, University, Gainesville, Fla.) Research supported by the Florida Power Corp. and U.S. Department of Energy, Contract No. EC-78 S 05 5624 Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1980 384 p. 879 refs \$29.50

Direct solar electrics are discussed along with wind-electrics, taking into account prior photovoltaic methods, present state-of-the-art and problems being addressed, site selection considerations, system integration of photovoltaics, economics aspects, barriers to photovoltaic integration, future R and D needed for integration, wind and the atmosphere, maximum energy via wind electrics, basics of wind energy conversion, prior wind electrics methods, system integration of wind electrics, and barriers to wind electric integration. Problems of energy storage and systems of solar-electrics are also examined, giving attention to system integration of energy storers, systems of solar-electric vehicles, and barriers to solar-electrics systems integration G R

A81-32446 The national solar optical materials program plan - An overview K D Masterson (Solar Energy Research Institute, Golden, Colo.) In Optics in adverse environments, Proceedings of the Seminar, Los Angeles, Calif., February 4, 5, 1980 Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1980, p. 250-254

A national plan for solar optical material research, coordinated by the Solar Energy Research Institute, is being developed with the goal of meeting 20% of the national energy needs with solar energy by the year 2000. Material functions of system components, including concentrators, receivers, energy transfer systems, and structures are studied. Optical material functions, i.e., absorption, reflection, and transmission of solar radiant energy, which provide high system performance, are examined, with a view to making conversion systems economically attractive. Research on glass and polymer materials for glazing and reflector components environmental testing, and long term reliability modeling are also given consideration. Programs supporting research and development and encouraging new product development commercialization, are presented, and an overview of the projected costs and the present value of performance improvements is given K S

A81-32750 * UV transmission through glass of commercial mirrors F L Bouquet (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *Solar Energy*, vol. 25, no. 6, 1980, p. 575, 576 5 refs. Research supported by the U.S. Department of Energy and NASA

A81-32853 The CRTF Real-Time Aperture Flux system D B Davis (Sandia Laboratories, Albuquerque, N. Mex.) In International Instrumentation Symposium, 26th, Seattle, Wash., May 5-8, 1980, Proceedings Part 2 Research Triangle Park, N.C., Instrument Society of America, 1980, p. 435-441

The Real-Time Aperture Flux system (RTAF) is a test measurement system designed to determine the input power/unit area (flux density) during solar experiments conducted at the Central Receiver Test Facility, Sandia National Laboratories, Albuquerque, New Mexico. The RTAF is capable of using both thermal sensors and photon sensors to determine the flux densities in the RTAF measuring plane. These data are manipulated in various ways to derive input power and flux density distribution to solar experiments (Author)

A81-32908 # Solar energy - When, where and how K J Touryan (Solar Energy Research Institute, Golden, Colo.) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0837* 19 p. 25 refs.

A comprehensive review is presented of the conversion technologies by which solar energy may be turned into useful end products. The degree of maturity of these technologies, which include photovoltaics, biomass conversion, and direct and indirect solar thermal conversion systems such as wind energy and ocean thermal gradients, ranges from those that are available commercially, such as hot water heating, to those that are in a robust embryonic stage, such as the production of ethanol from woody biomass. The cost, performance, market potential and environmental/social impact of these technologies are considered to determine (1) what fraction of the U.S. energy budget will be solar in the short, middle, and long terms, and (2) what the mix and distribution of these technologies will be in the year 2000 O C

A81-32932 * # Sun powered aircraft design P B MacCready, P B S Lissaman (AeroVironment, Inc., Pasadena, Calif.), W R Morgan (AeroVironment, Inc., Sun Valley, Calif.), and J D Burke (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0916* 14 p.

Two piloted aircraft have been developed and flown powered solely by photovoltaic cells in a program sponsored by the DuPont Company. The 30.8 kg (68-lb), 21.6 m (71-ft) span, Gossamer Penguin was used as a solar test bed, making a 2.6 km (1.6 mile) flight in August 1980. The 88.1-kg (194-lb), 14.3-m (47-ft) span Solar Challenger was developed for long flights in normal turbulence. Stressed to +9 G, it utilizes Kevlar, Nomex honeycomb-graphite sandwich wall tubes, expanded polystyrene foam ribs, and Mylar skin. With a 54.9 kg (121-lb) airframe, 33.1-kg (73-lb) propulsion system, and a 45.4-kg (100-lb) pilot, it flies on 1400 watts. In summer, the projected maximum climb is 1.0 m/s (200 ft/min) at 9,150 m (30,000 ft). Sixty purely solar powered flights were made during winter 1980-1981. Using thermals, 1,070 m (3,500 ft) was reached with 115 minute duration (Author)

A81-32971 The design and performance of an 11 kw Solar Array Simulator D R Smith (Sandia Laboratories, Albuquerque, N. Mex.), G A O'Sullivan, and F K O'Sullivan (Abacus Controls, Inc., Somerville, N.J.). In PESC '80, Power Electronics Specialists Conference, Atlanta, Ga., June 16-20, 1980, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 220-225. Research supported by the U.S. Department of Energy

A Solar Array Simulator combines a high efficiency switching regulator, and a low power analog adjustable I-V generator to duplicate the static and dynamic characteristics of photovoltaic cells operated in series-parallel combinations. Both voltage and current feedback are used to control the switching and series regulators. Stability of the series regulator over a wide range of load time

constants is achieved by a compensation technique of Roberge (1975) Current voltage and transient response characteristics of the simulator are presented The device was also operated into a 10 kw inverter designed for photovoltaic applications (Author)

A81-32972 A line interfaced inverter with active control of the output current waveform M F Schlecht (MIT, Cambridge, Mass) In PESC '80, Power Electronics Specialists Conference, Atlanta, Ga, June 16-20, 1980, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1980, p 234-241 Research supported by the Lutron Electronics, Inc

A line interfaced inverter for photovoltaic systems is presented This inverter employs a high frequency dc-chopper for shaping the output current, providing unity power factor operation and minimizing the size of the output filter The isolation of the solar array from the utility is accomplished with a high frequency transformer, eliminating the need for large, 60 Hz magnetics The dynamics of the power circuit are analyzed to determine proper compensation of the output current control loop This analysis shows that a minor loop is required to stabilize the power circuit and that system response varies during the 60 Hz cycle A parity simulation of the power circuit/control system is performed to verify this analysis The results of this simulation are presented and compared to waveforms from a test inverter The special considerations required for properly loading a photovoltaic array with a line interfaced inverter are discussed (Author)

A81-32976 Precise regulation of multiple output voltages in a dc-dc converter H Matsuo and F Kurokawa (Nagasaki University, Nagasaki, Japan) In PESC '80, Power Electronics Specialists Conference, Atlanta, Ga, June 16-20, 1980, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1980, p 275-283 13 refs Research supported by the Hoso Bunka Foundation

A dc-dc converter capable of precise regulation of multiple output voltages has been developed which is composed of an improved forward type multiple-output converter and step-down type single-output converters The steady state and dynamic characteristics of the converter are verified theoretically and experimentally and it is shown that sufficiently precise regulation of multiple output voltages can be accomplished for large changes of each load, for no-load and full-load conditions It is also demonstrated that the converter has a sufficiently high conversion efficiency V L

A81-33089 Hydrides of intermetallic compounds H Oesterreicher (California, University, La Jolla, Calif) *Applied Physics*, vol 24, Mar 1981, p 169-186 126 refs Research supported by the U S Department of Energy

Theoretical and experimental research related to the hydrides of intermetallic compounds is reviewed with emphasis on structure, stability, solid-state properties, catalysis, and kinetics It is shown that the stability and composition of hydride phases can be understood in many cases in terms of weighted contributions of the elements (pseudoelement rule), with spatial parameters representing additional constraints The future areas of research are outlined with relevance to the fields of metallurgy, magnetism, general quantum solid and lattice gas effects, as well as surface physics V L

A81-33227 Analysis of high-efficiency silicon solar cells H T Weaver and R D Nasby (Sandia Laboratories, Albuquerque, N Mex) *IEEE Transactions on Electron Devices*, vol ED-28, May 1981, p 465-472 23 refs

Performance data on high efficiency concentrator (greater than 18 percent at 25 suns) silicon solar cells are compared to results from an exact numerical model in which all parameters for the calculation are taken from the existing literature on bulk silicon The numerical solution of the transport equations includes the effects of Fermi-Dirac statistics, bandgap narrowing, and Auger recombination Cell performances as a function of sunlight concentration are predicted with reasonable accuracy using this model Evidence for the existence of bandgap narrowing effects is found by comparing experimental data to calculated values of spectral quantum efficiencies and open-circuit voltages under a variety of lifetime assumptions The validity of using superposition with simple diode equations to

approximate the behavior of silicon solar cells also is examined (Author)

A81-33233 * Transport velocity transformation - A convenient method for performance analysis of multilayer solar cell structure M Wolf (Pennsylvania, University, Philadelphia, Pa) *IEEE Transactions on Electron Devices*, vol ED 28, May 1981, p 566-573 24 refs Research supported by the U S Department of Energy and NASA

It is noted that in the case of low level injection, space charge quasi-neutrality, and spatially constant material parameters (including an electrostatic field), the individual layer can be treated analytically and the basic solar cell performance parameters can be evaluated from three equations The first equation represents the transformation of the transport velocity across the layer from the other layer boundary The second establishes the light generated current output from the layer interface, under the influence of the transport velocities and minority carrier density at both layer boundaries and of bulk recombination The third equation describes the flow of these carriers across other layers The power of the approach is considered to lie in its facility for analysis of the solar cell's performance layer by layer, giving a clear picture of the individual layer's influence on cell efficiency C R

A81-33267 Natural convection losses in a flat solar energy converter (Pertes par convection naturelle dans un convertisseur plan d'énergie solaire) A A Chikhaoui, Y Severi, and J Marcellat (Aix-Marseille I, Université, Marseille, France) *Académie des Sciences (Paris), Comptes Rendus, Serie II - Mécanique, Physique, Chimie, Sciences de l'Univers, Sciences de la Terre*, vol 292, no 9, Mar 2, 1981, p 693-696 9 refs In French

Heat losses due to natural convection in a flat solar energy converter at Rayleigh numbers from 2000 to 2,000,000 are investigated Determinations of heat fluxes were performed in a model collector consisting of an air filled enclosure with an electrical ly heated brass plate covered with a thin plate of aluminum, a glass cover free of thermal stresses, and glass side walls of adjustable height, with a variable inclination to the horizontal The temperature of the cold glass cover is found to depend primarily on the height and inclination of the box and to a much lesser extent on the temperature of the heated brass plate Both the Nusselt number and the mean glass temperature are found to be at a maximum at an inclination of approximately 20 deg Expressions are derived relating the Nusselt number to the Rayleigh number and inclination for cases of two and three dimensional convection A L W

A81-33448 Utility integration issues of residential photovoltaic systems Z A Yamayee and J Peschon (Systems Control, Inc, Palo Alto, Calif) *Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, Ga, Feb 1-6, 1981, Paper 81-WM-109-8* *IEEE Transactions on Power Apparatus and Systems*, vol PAS-100, May 1981, p 2365-2373 23 refs Contract No DE-AC01-79ET-29349

The economic aspects of residential solar photovoltaic (SPV) systems are discussed from the electric utility perspective The following schemes of SPV integration are considered (1) SPV with complete utility buy-back and backup, (2) SPV with utility system storage, and (3) SPV with residential storage Estimates are made of the price that the utility might pay for SPV owner's surplus energy compared to what it would charge for deficits by evaluating economic savings of SVP to the utility V L

A81-33543 * # The role of large space systems R F Carlisle and J D DiBattista (NASA, Washington, D C) *American Astronautical Society and American Institute of Aeronautics and Astronautics, Annual Meeting on Space Enhancing Technological Leadership, Boston, Mass, Oct 20-23, 1980, AAS Paper 80-275* 12 p 6 refs

Potential NASA missions utilizing large space systems are outlined With reference to the Mobile Communications Satellite, four conceptual antenna configurations are described and compared The Science and Applications Space Platform is described and the development of a power utilization package is examined The package would be left on orbit and would provide a cost effective means for collecting sunlight energy, storing it and providing power to Shuttle and payloads S C S

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A81-33741 Black chromium-molybdenum - A new stable solar absorber. G B Smith (Houston, University, Houston, Tex., New South Wales Institute of Technology, Broadway, Australia) and A Ignatiev (Houston, University, Houston, Tex.) *Solar Energy Materials*, vol 4, Jan-Feb 1981, p 119-133 16 refs Research supported by the US Department of Energy and University of Houston

A new solar selective black which is more stable at high temperatures in air than standard black chrome has been electrodeposited. It is based on two refractory metals and their oxides, chromium and molybdenum. Their micromorphology is the same as found in black chrome and the solar absorption mechanisms are similar. Plating mechanisms are discussed and related to film structure. Chemical structure via X-ray photoelectron spectroscopy and Auger electron spectroscopy as a function of depth reveal important differences to the structure of standard black chrome which affect stability but not optical response before heating. Absorbance is stable at a value of 0.95 to at least 425°C in air in the best composites which have Mo/Cr ratios of about 0.05. The molybdenum is not present as metal and the total metallic Cr content decreases as the Mo content increases. The Mo percentage is very high near the surface of the film. (Author)

A81-33743 Indium-tin-oxide transparent conducting coatings on silicon solar cells and their 'figure of merit'. V K Jain (Solid State Physics Laboratory, Delhi, India) and A P Kulshreshtha (Solid State Physics Laboratory, Delhi, Indian Space Research Organization, Satellite Centre, Bangalore, India) *Solar Energy Materials*, vol 4, Jan-Feb 1981, p 151-158 11 refs

A81-33744 Evaluation of silicone foam for flat plate solar collector insulation. J A Rabe, S Spells, D M Rasch, G R Homan, and C L Lee (Dow Corning Corp., Silicone Research Dept., Midland, Mich.) *Solar Energy Materials*, vol 4, Jan-Feb 1981, p 159-168 7 refs Research supported by the US Department of Energy

A81-33745 Preparation of stable efficient CdSe films for solar PEC cells. D J Miller and D Haneman (New South Wales, University, Kensington, Australia) *Solar Energy Materials*, vol 4, Jan-Feb 1981, p 223-231 20 refs Research supported by the National Energy Research Development and Demonstration Council

The techniques of fabricating low cost electrodeposited CdSe films for solar conversion cells are described and discussed. Advantages of the method, attainable goals, and result of annealing, etching and double-sided illumination are discussed. Data is presented for various films with Ni and Ti substrates. It appears that the present circa 3% efficiency, at a peak watt cost lower than from current Si cells, can be improved by a factor of 3. (Author)

A81-33746 Structure of annealed and unannealed CdSe films for photoelectrochemical solar energy conversion. K T L de Silva, D J Miller, and D Haneman (New South Wales, University, Kensington, Australia) *Solar Energy Materials*, vol 4, Jan-Feb 1981, p 233-243 13 refs Research supported by the National Energy Research Development and Demonstration Council and Australian Research Grants Committee

CdSe thin film photoelectrodes show a substantial increase in solar energy conversion efficiency after annealing. Measurements of the changes that occur in the films were made by electron and X-ray diffraction, scanning electron microscopy and X-ray photoelectron spectroscopy. The grain size of the films was found to increase from 0.01-0.03 to 0.1-0.3 micron but the grains showed a high density of stacking faults. Annealing also results in the formation of CdSe and the liberation of Se from the surface region. The results are discussed in relation to solar energy conversion efficiency. (Author)

A81-33747 Free molecule thermal conduction in concentric tubular solar collectors. G L Harding and B Window (Sydney, University, Sydney, Australia) *Solar Energy Materials*, vol 4, Mar 1981, p 265-278 26 refs Research supported by the University of Sydney

The thermal conduction between two concentric tubes with various surfaces has been determined for low pressures of H₂, He, Ar, CO, N₂ and H₂O in the annular region. From the results the

temperature dependent accommodation coefficients for these gases on a glass surface, on a sputtered copper surface and on a metal-carbon selective absorber have been deduced. They are generally higher than predicted from simple classical theory, with the accommodation coefficient approaching one for the selective surface in particular for all gases except helium and hydrogen. The results can be explained in terms of the electrostatic interactions between molecules and the walls and in terms of microscopic porosity of the surfaces. They are relevant to modelling the degradation of evacuated tubular collectors. (Author)

A81-33748 ESR in CVD silicon and silicon carbon alloys. P J Gaczi (Chicago, University, Chicago, Ill.) and D C Booth (Arizona, University, Tucson, Ariz.) *Solar Energy Materials*, vol 4, Mar 1981, p 279-289 19 refs NSF Grant No DMR-77-11683, Contract No ER-78-S 02-4899

Electron spin resonance (ESR) is reported in three groups of chemical vapor deposited silicon films. It is noted that group I films are amorphous Si(x)C(100-x) alloys prepared from silane and acetylene at a substrate temperature of 630°C that have a spin density of 3×10^{19} to 10^{20} /cm³. The silicon carbon films have been developed as structurally stable selective absorbers for photo-thermal solar energy conversion. Group II films are nonalloyed amorphous silicon films prepared below 660°C that have a spin density of 1×10^{19} to 10^{20} /cm³, while group III films are polycrystalline films prepared above 670°C with a density of 0.5×10^{20} to 10^{21} /cm³. The exchange interaction between spins is sufficiently strong in the group I silicon carbon alloys so that an average g value is observed and no evidence of superposition is found in agreement with the amorphous Si-Ge results of Kumeda et al (1977). ESR saturation and line broadening as a function of microwave power in samples representative of the three groups is observed. A trend, in the order group III, II, I, is found of increasing spin system homogeneity, indicating that the exchange coupled spin clusters contain increasing numbers of spins. C R

A81-33749 Efficient and stable photoelectrochemical cells constructed with WSe₂ and MoSe₂ photoanodes. G Kline, K Kam, D Canfield, and B A Parkinson (Iowa State University of Science and Technology, Ames, Iowa) *Solar Energy Materials*, vol 4, Mar 1981, p 301-308 25 refs Contracts No W-7405 eng 82, No XP 9 8198 1

Single crystals of n-WSe₂ and n-MoSe₂ were grown and employed as the photoanode in a regenerative photoelectrochemical cell with an iodide/triiodide electrolyte. Solar to electrical power conversion efficiencies of 10.2 and 9.4% were achieved on selected crystals of WSe₂ and MoSe₂, respectively. Products of a photo corrosion reaction from a MoSe₂ electrode could not be detected in the electrolyte after one month of continuous operation. The photocurrent spectra and optimization of the electrolyte are also discussed. (Author)

A81-33750 Microstructural and mechanical property evaluation of zinc oxide coated solar collectors. C Homhual, O T Inal, L E Murr, A E Torma, and I Gundiler (New Mexico Institute of Mining and Technology, Socorro, N Mex.) *Solar Energy Materials*, vol 4, Mar 1981, p 309-332 15 refs Contract No ER-78-04-4226

A81-33751 Microstructural and mechanical property evaluation of black-chrome coated solar collectors. II. O T Inal, M Valayapetre, L E Murr, and A E Torma (New Mexico Institute of Mining and Technology, Socorro, N Mex.) *Solar Energy Materials*, vol 4, Mar 1981, p 333-358 23 refs Contract No ER-78 04 4266

A81-33776 An improved analysis of the Schottky barrier solar cell. C M H Klimpe and P T Landsberg (Southampton, University, Southampton, England) *Solid-State Electronics*, vol 24, May 1981, p 401-406 16 refs

By discarding the depletion approximation and the assumption of constant quasi-Fermi levels, the actual shape of these levels is computed in a Schottky barrier solar cell for what is believed to be the first time. Additional improvements in the theory concern the dependence of the barrier height on the density of interfacial states, the various potential drops in the cell and the allowance for the communication between the metal and interfacial surface states in the treatment of recombination through the interfacial states. The principal result is that a universal model is now available on which it

can be shown quantitatively that (1) the quasi Fermi levels have extrema separated by more than the output voltage and separated by a distance of the order of 1 micron and that (2) thin substrates (approximately 4 microns) give rise to large hole diffusion currents near the ohmic back contact which is modeled by assuming infinite surface recombination velocity. It replaces as the principal loss mechanism the recombination in the semiconductor which dominates for thick (approximately 200 microns) substrates. C R

A81-33777 Operating limits of Al-alloyed high-low junctions for BSF solar cells. J del Alamo, J Eguen, and A Luque (Madrid, Universidad Politecnica, Madrid, Spain). *Solid State Electronics*, vol 24, May 1981, p 415-420. 25 refs.

Experimental estimations of the effective surface recombination velocity of the high low junction and of the base diffusion length are carried out for Al-alloyed n(p+)(p+) bifacial cells and the results are presented in form of histograms. These results agree with calculated values of the effective surface recombination velocity when the characteristics of the recrystallized Si layer and heavy doping effects are taken into account. It is concluded that thick Al layers and high alloying temperatures (over 800 C) are necessary to obtain low values of the velocity. This conclusion agrees with experimental results of other authors. Recommendations to avoid diffusion length degradation are given and the operating limits of the Al alloying technology are discussed. (Author)

A81-33781 Transient thermal effects in an enclosed water body due to heated water discharge for heat rejection and solar energy storage. S K Gupta (Indian Institute of Technology, Delhi, India) and Y Jaluria (Indian Institute of Technology, Kanpur, India). *Energy Conversion and Management*, vol 21, no 1, 1981, p 3-8. 9 refs. Research supported by the Council of Scientific and Industrial Research.

A81-33786 Salt gradient stabilized solar pond collector. P K Bansal and N D Kaushik (Indian Institute of Technology, New Delhi, India). *Energy Conversion and Management*, vol 21, no 1, 1981, p 81-95. 24 refs.

A theoretical analysis of a salt gradient pond as a steady state flat plate solar energy collector is presented, taking into account the convective heat and mass flux through the pond surface and evaluating the temperature and heat fluxes at various levels in the pond by solving the Fourier heat conduction equation with internal heat generation. The resultant efficiency equation is a Hottel-Whillier-Bliss type which is commonly used for flat plate solar energy collectors. Numerical computations to investigate the optimization of geometrical and operational parameters of the solar pond are presented. The maximum efficiencies for a solar pond collector having the upper convective zone as 0.1 m at collection temperatures 40, 60, 80, and 100 C are 36.8%, 32.10%, 29.10%, and 26.9% respectively. The corresponding values for a flat plate collector with two glass covers are 52%, 26%, 3%, and less than 1%. Thus, at higher collection temperatures, the solar pond collector is more efficient than a flat plate collector with the cost of a solar pond collector also expected to be less than that of a flat plate collector. K S

A81-33995 Dopant profile analysis of boron in solar grade poly- and single crystalline silicon. G C Jain, B C Chakravarty, and S N Singh (National Physical Laboratory of India, New Delhi, India). *Applied Physics Letters*, vol 38, May 15, 1981, p 815-817. 16 refs. Research supported by the Ministry of Industrial Development.

The dopant profiles have been measured by anodic sectioning for 10 ohm cm resistivity poly- and single crystalline silicon of n-type conductivity. Boron diffusion was carried out for 10 min in an ambient mixture of argon and oxygen at 1075 C. The surface concentration is 1.8×10^{20} to 2.0×10^{20} atoms per cm² for both poly- and single crystal silicon. The junction depth, however, is 7800 Å in polycrystalline silicon and 6950 Å in single crystals. The diffusion profile observed in polycrystalline silicon, which also differs from that of the single crystal silicon in its shape, is shown to be more suited to solar cell fabrication than the profile in single crystals. V L

A81-34749 Improved GaAs metal-oxide semiconductor solar cells with a spin-on oxide layer. P Sircar and R Dat (Howard University, Washington, D C). *Canadian Journal of Physics*, vol 59, May 1981, p 716, 717. 10 refs.

A81-34806 Gap states and ESR of boron-doped CVD amorphous silicon. T Nakashita, M Hirose, and Y Osaka (Hiroshima University, Hiroshima, Japan). *Japanese Journal of Applied Physics*, vol 20, Mar 1981, p 471-475. 11 refs.

A81-35006 On the upper limit of the energy conversion efficiency in tandem solar cells. C C Grosjean and A De Vos (Gent, Rijksuniversiteit, Ghent, Belgium). *Journal of Physics D - Applied Physics*, vol 14, May 14, 1981, p 883-894. 5 refs.

A mathematical analysis is presented of the complicated functional dependence of solar energy conversion on temperature and light concentration ratio for a photovoltaic device consisting of an infinite number of solar cells. Equations are obtained which may be useful for the efficiency prediction of practical tandem implementations. V L

A81-35122 High-low junctions for solar cell applications. J del Alamo (Madrid, Universidad Politecnica, Madrid, Spain), J van Meerbergen, F D'Hoore, and J Nus (Leuven, Katholieke Universiteit, Heverlee, Belgium). *Solid-State Electronics*, vol 24, June 1981, p 533-538. 26 refs.

A new theoretical model to calculate the effective surface recombination velocity of a high-low junction with an arbitrary impurity distribution is presented. The model is applied to erfc-diffused p(p+) junctions using experimental data of bandgap narrowing, lifetime and mobility. Bandgap narrowing is shown to degrade the minority carrier reflecting properties of the high low junction. Computer results are applied to the design of BSF solar cells and to study other solar cell structures based on high-low junctions. (Author)

A81-35136 Calorimetric measurement of absorptance and emittance of the Sydney University evacuated collector. G L Harding and T T Moon (Sydney University, Sydney, Australia). *Solar Energy*, vol 26, no 4, 1981, p 281-285. 9 refs. Research sponsored by the University of Sydney.

Simple calorimetric techniques have been developed for determining the absorptance and emittance of individual evacuated tubular collectors incorporating a selective surface, and the efficiency of evacuated collectors in various mirror systems. The absorptance and efficiency measurements are made in natural sunlight without the use of a solarimeter by establishing an absorptance standard based on Nextel black paint. Calibration of solarimeters using the established absorptance standard is discussed. Emittance measurements are made by measuring radiative heat losses from the absorber tube of a collector. Absorptance and emittance measurements for a number of Sydney University evacuated collectors gave values of absorptance of 0.92 ± 0.01 and emittance of 0.05 at 120°C for the selective surface utilized. Efficiency measurements for Sydney University collectors in two simple mirror systems are also reported. (Author)

A81-35137 Integrated performance of liquid-based solar heating systems. W F Phillips (Utah State University of Agriculture and Applied Science, Logan, Utah). *Solar Energy*, vol 26, no 4, 1981, p 287-295. 15 refs.

A closed form model for the integrated performance of liquid based solar heating systems is presented. The model is general enough to be used for most liquid based systems. It can be used for systems with either flat plate or concentrating collectors and the load is not restricted to space heating applications. Three new system parameters are introduced by this model. These are the system heat storage factor, the solar distribution factor and the load distribution factor. These three factors respectively account for the reduction in system performance which results from finite storage, non uniform solar flux and non-uniform load. These factors are discussed in detail and closed form mathematical expressions, from which numerical values can be calculated, are presented. (Author)

A81-35138 Nonlinear dynamic model of a solar stream generator. A Ray (Charles Stark Draper Laboratory, Inc., Cambridge, Mass). *Solar Energy*, vol 26, no 4, 1981, p 297-306. 17 refs.

A thermal-hydraulic model of a once-through subcritical steam generator has been developed for predicting dynamic characteristics.

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of solar thermal power plants as well as for control system design. The purpose of the model is to evaluate the overall system performance and component interaction with sufficient accuracy for controller design, rather than to describe the microscopic details occurring within the steam generator. The three section (compressed water, two phase mixture, and superheated steam) model with time varying phase boundaries is described by a set of nonlinear differential equations derived from conservation of mass, momentum and energy. Local stability of the model has been examined at different levels of insolation. Transient response of six plant variables due to independent step disturbances in three input variables are presented as typical results. (Author)

A81-35139 Residential application of refrigerant-charged solar collectors. J. M. Schreyer (Oak Ridge National Laboratory, Oak Ridge, Tenn.) *Solar Energy*, vol. 26, no. 4, 1981, p. 307-312. Contract No. W-7405 eng 26

A fluorocarbon (trichlorofluoromethane) loaded solar collector system was installed and evaluated. It demonstrated 83 percent energy recovery at a low collector temperature difference of approximately 10 °C. The maximum peak energy picked up by the collector surface was 2.8 MJ/sq m hr (250 Btu/hr-sq ft). The heat transfer medium is relatively nontoxic, noncorrosive and nonfreezing in cold climates. In this application it circulates by natural convection, therefore, the system requires no pump or electronic control in the primary loop. (Author)

A81-35140 A theoretical study of heat transfer in a flat-plate solar collector. G. M. Naidu and J. P. Agarwal (Indian Institute of Technology, Kharagpur, India) *Solar Energy*, vol. 26, no. 4, 1981, p. 313-323. 14 refs

The development of thermal boundary layers in a flat plate solar collector is investigated. The temperature profiles within the collector are represented as fourth degree polynomials, with flow velocity profiles assumed to be uniform or parabolic and heat losses from the absorber plate taken to be proportional to an arbitrary dimensionless power of the temperature difference. Equations for the temperature profiles, heat flux and dimensionless length required for full boundary layer development are derived and solved for the cases of negligible heat losses, heat losses varying linearly with the temperature difference, and heat losses varying as the square of the temperature difference. It is found that, in the case of heat loss, the Nusselt number for heat transfer in the fully developed region with parabolic velocity profile agrees with the exact value. For cases of heat loss, the efficiency of the solar collector is found to decrease with increases in the product of the heat loss coefficient with the dimensionless length, and in the product of the Peclet number with the heat loss coefficient. A. L. W.

A81-35141 Optical collection efficiencies of arrays of tubular collectors with diffuse reflectors. B. Window and J. Zybert (Sydney, University, Sydney, Australia) *Solar Energy*, vol. 26, no. 4, 1981, p. 325-331. 7 refs. Research supported by the University of Sydney and Science Foundation for Physics.

Optical collection efficiencies are calculated for arrays of evacuated tube solar collectors characterized by various collector spacings and diffuse reflectors of various geometries as a function of the angular distribution of incident solar radiation. A Monte Carlo ray tracing program is used to follow photon scattering, reflection, refraction and absorption for input radiation distributions corresponding to diffuse solar radiation, solar radiation at midday, and approximate daily averages for collectors aligned in the north-south and east-west directions. When the effects of absorptance in a white diffuse reflector are taken into account, the planar diffuse reflector is found to perform as well as reflectors of more complex geometry. The optimum spacing for the planar reflector is shown to be at the first maximum in collection efficiency for normal incidence radiation, while collector spacings less than two diameters produce only minor increases in collector performance. Results also demonstrate the importance of multiple reflections, and small advantages in collector efficiencies for tubes aligned in the north-south direction. A. L. W.

A81-35143 Optical collection efficiencies of tubular solar collectors with specular reflectors. B. Window and I. M. Bassett (Sydney, University, Sydney, Australia) *Solar Energy*, vol. 26, no. 4,

1981, p. 341-346. 9 refs. Research supported by the Science Foundation for Physics and University of Sydney.

The optical collection efficiencies of arrays of evacuated tubular collectors with specular involute reflectors have been studied using computer ray tracing techniques incorporating all the major physical features. The optical collection efficiencies under various representative assumptions concerning the angular distribution of incident radiation are presented as functions of the tube to tube spacing. The hemispherical collection efficiency obtained with collector aperture equal to absorber surface is in accordance with the expected loss resulting from the truncation of the reflector, and the losses associated with the mirror, with the envelope and with the absorber. At smaller apertures, the collection efficiency for hemispherically incident radiation agrees with a recent theory of O'Gallagher et al. (Author)

A81-35639 # Physical processes in a solar power plant with heliostats and a tower (Procese fizice într-o centrală termică solară cu câmp de heliostate și turn). V. L. Fara, R. Grigorescu, V. Badescu, and R. Chisileag (Bucuresti, Institutul Politehnic, Bucharest, Rumania) *Studii si Cercetari de Fizica*, vol. 33, no. 4, 1981, p. 359-371. 10 refs. In Rumanian.

Meteorological, optical, thermal and mechanical phenomena affecting the work cycle of a solar power plant are analyzed by considering the interactions among these factors. Also considered are the three stages of the plant: active, non active (no sun) and damaged conditions. By determining the correlation functions of all the parameters, optimal design data can be obtained. N. D.

A81-35643 # Probabilistic estimation of the concentration error of solar radiation (O estimare probabilistica a erorii de concentrare a radiatiei solare). V. Badescu (Intreprinderea de Fibre Artificiale Viscofil, Bucharest, Rumania) *Studii si Cercetari de Fizica*, vol. 33, no. 5, 1981, p. 455-464. 6 refs. In Rumanian.

Mathematical relations are established for the estimation of the radiation concentration errors, based on the specificity of the orientation system and the geometric probability theory. The stopping point of the track and the final correction are correlated and a probability density function is obtained. The asymmetric character of the dispersion of the reflected rays results from the analysis of the concentration system noting that the distribution in the focal center is done through the misalignment of the orientation system opposite the median deviation. Two numerical examples are given. N. D.

A81-35694 # Effect of adiabatic coplanar extension surfaces on wind-related solar-collector heat transfer coefficients. E. M. Sparrow and S. C. Lau (Minnesota, University, Minneapolis, Minn.) *ASME, Transactions, Journal of Heat Transfer*, vol. 103, May 1981, p. 268-271. 5 refs. Research sponsored by the American Society of Heating, Refrigerating and Air Conditioning Engineers.

Wind tunnel experiments have been carried out with the objective to develop a technique for diminishing wind related forced convection heat transfer coefficients at the exposed surface of a flat plate solar collector. Various plate framing configurations have been investigated and it has been found that wind-related heat losses can be reduced through the use of an adiabatic coplanar frame. An equation is derived which provides a simple way of estimating the reduction of the heat transfer coefficient. It is also shown that framing along the side edges is more efficient in reducing the heat transfer coefficient than framing along the leading and trailing edges, while framing along the trailing edge is more beneficial than framing along the leading edge. V. L.

A81-35823 # Optimization of the optical properties of multilayer selective coatings (Optimizatsia opticheskikh kharakteristik mnogosloynnykh selektivnykh pokrytiy). M. M. Koltun and I. P. Gavrilova. *Zhurnal Prikladnoi Spektroskopii*, vol. 34, Apr 1981, p. 749-751. 9 refs. In Russian.

The paper considers the optimal characteristics of selective coatings (used, for example, in solar energy converters) with a high ratio of absorptivity in the appropriate solar spectral range to the emissivity factor. Metal-ceramic coatings have been fabricated using vacuum vapor deposition of successive layers of dielectric and semitransparent metal, the electrochemical deposition of thermal-emission layers, and the simultaneous vacuum vaporization of

dielectric and metal (or their mixture) Maximum values of the ratio of solar-radiation absorptivity to emissivity factor have been calculated for coatings on a copper substrate in the 27-500 C temperature range, and calculated results have been qualitatively confirmed by experimental results B J

A81-35988 # Selective layers for highly effective solar collectors W Scherber and B Schroder *Dornier-Post* (English Edition), no 1, 1981, p 10-15

Attention is given to enhancing the performance of solar collectors by the use of selective surfaces In comparison to normal black absorbers, the selective surfaces have a better starting performance, a higher heat yield, higher operating temperatures and a higher storage capacity Solar radiation and heat radiation are in separate spectral ranges The desired spectral profile can be implemented by interference or semiconductor effects Two types of layers based on surface structure filters have been developed (1) structural elements of or about the size of the light wave length where the absorption process occurs by the dispersion effects at the individual structure and (2) structural elements considerably smaller than the light wave length where a small fraction of the light is reflected while the remainder is absorbed in the interior The state-of-the-art in selective surfaces is outlined S C S

A81-35989 # Test stands for solar collector evaluation T Flesch *Dornier-Post* (English Edition), no 1, 1981, p 16, 17

Collector test stands have been developed for particular adaptation to individual countries Long term testing is used to evaluate collector reliability and collector service life Test stands for four collectors have been developed in Mexico and plans for flat-plate collector test stands and for test facilities for concentrating collectors have been proposed S C S

A81-36574 Photoactivation of CdSe films for photoelectrochemical cells C-H J Liu, J Olsen, D R Saunders, and J H Wang (New York, State University, Buffalo, NY) *Electrochemical Society, Journal*, vol 128, June 1981, p 1224-1228 6 refs NSF Grant No PCM-77-55002

The efficiency of photoelectrochemical cells with thin film CdSe electrodes can be enhanced by illuminating the semiconductor electrode in salt solution under closed-circuit condition The photoactivation mechanism involves the photooxidation of CdSe to elemental selenium with concomitant release of cadmium ions into the salt solution and subsequent reductive dissolution of the resulting layer of elemental selenium This method can be controlled more precisely than acid etching and hence is more suitable for large scale application (Author)

A81-36575 Estimation of series resistance losses and ideal fill factors for photoelectrochemical cells P Singh, K Rajeshwar, R Singh, and J DuBow (Colorado State University, Fort Collins, Colo) *Electrochemical Society, Journal*, vol 128, June 1981, p 1396-1398 10 refs Contract No XP 9 8002-9

A simple method is presented for estimating series resistance losses and ideal fill factors for a given photoelectrochemical device from current-voltage measurements at varying light intensity This method is demonstrated on a model photoelectrochemical device comprising the n GaAs/AlCl₃ butyl pyridinium chloride, ferrocene/ferricinium ion couple/C system The extent to which the photo voltaic output is degraded by high series resistance losses can be directly estimated using the present approach (Author)

A81-36702 # Thermodynamic analysis and optimization of the cycle parameters of regenerative gas-turbine converters for solar power stations /SGTS/ (Termodinamicheskiy analiz i optimizatsiya parametrov tsiklov regenerativnykh gazoturbinnnykh preobrazovatelei dlia solnechnykh energoustanovok /SGTU/) L M Drabkin (Vsesoiuznyi Zaochnyi Institut Inzhenerov Zheleznodorozhnogo Transporta, Moscow, USSR) *Geliotekhnika*, no 2, 1981, p 11-21 6 refs In Russian

A thermodynamic analysis compares the efficiency of a simple solar-driven helium gas turbine generator with two improved schemes employing regeneration of heat from the recirculating working fluid One scheme uses a recuperator based on direct heat exchange while the other recovers heat by thermoelectric conversion in addition to the recuperator The specific area of the heat exchange surface is

calculated along with other system parameters for maximum thermodynamic cycle efficiency Gains of up to 15% are demonstrated T M

A81-36704 # Some results from field testing of a solar energy* receiving element to be used with a solar gas turbine installation (Nekotorye rezul'taty naturnykh ispytaniy geliopriemnika dlia solnechnoi gazoturbinnnoi ustanovki) G Ia Umarov, P U Khatamov, A K Alimov, and L M Drabkin (Vsesoiuznyi Zaochnyi Institut Inzhenerov Zheleznodorozhnogo Transporta, Moscow, USSR, Akademiya Nauk Uzbekskoi SSR, Fiziko Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no 2, 1981, p 32-37 In Russian

Description of the design and testing of a solar concentrator and heating coils used as an integral conversion element driving the working gas in a solar-powered turbine generating facility A 5 meter, faceted parabolic mirror heats the fluid in a system of conically and cylindrically spiralled, stainless steel coils Curves illustrate temperature distributions in the system at specific operating conditions Calculated heat yields from different areas of the system are also tabulated T M

A81-36708 # Experimental study of a solar thermoelectric generator with a heat pipe (Eksperimental'noe issledovanie STEG s teplovoi truboi) Ch Agabaev, N V Kolomoets, M A Markman, L M Simanovskii, V M Rzevskii, and V T Kamenskii (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) *Geliotekhnika*, no 2, 1981, p 66-68 In Russian

A heat pipe was incorporated in the design of a solar thermoelectric generator in order to moderate heat loads in the system and thus enhance the efficiency and longevity of the unit Test data illustrate the solar energy dependence of the generated electric power and of the thermal fluxes in the thermoelectric modules An analysis of energy losses provide further design recommendations T M

A81-36709 # Investigation of the thermal regime in a one-floor dwelling with a solar heating system (Issledovanie teplovogo rezhima odnoetazhnogo pomescheniya s sistemoi solnechnogo obogreva) R R Avezov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) and O Azimov (Samarkandskii Gosudarstvennyi Arkhitekturno Stroitel'nyi Institut, Samarkand, Uzbek SSR) *Geliotekhnika*, no 2, 1981, p 69-73 5 refs In Russian

Description of the design and operational characteristics of a single ground floor residential solar heating system featuring structural separation of the collector from the accumulator for increased comfort and versatility Air passing past an isolated, thermopane-protected collector moves through a ventilation system onto final heat storage, in an accumulation system Moving warm air provides heating in daytime, while radiation from the accumulator maintains nighttime temperature Vent controls regulate optimal heating conditions T M

A81-36710 # Focusing heliostats of solar power stations (Fokussiruyushchie geliostaty solnechnykh energeticheskikh stantsii) R A Zakhidov and Sh I Klychev (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe Biuro Nauchnogo Priboro-stroeniya, Uzbek SSR) *Geliotekhnika*, no 2, 1981, p 81-83 In Russian

Description of an analytical procedure for designing large solar reflectors with movable mirror elements to enable focal adjustments for optimal energy utilization A general expression describes variation of the reflector curvature as a function of the time of day and season of the year The method was programmed in ALGOL for computer aided design purposes T M

A81-37020 Net energy analysis of space power satellites C C Frantz and A B Cambel (George Washington University, Washington, D C) *Energy* (UK), vol 6, June 1981, p 485-501 10 refs Contract No EG-77-G 01-4040

A net energy analysis (NEA) of the Solar Power Satellite System is performed Two options are compared using either silicon (Si) or gallium-aluminum arsenide (Ga Al-As) photovoltaic cells The analysis is based on the DOE/NASA reference system Maintenance and material energy costs are considered and are shown to be valid

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Results show a net energy ratio (electrical output vs primary thermal input) of the order of 2.5 for the silicon cell option and 14-18 for the gallium aluminum-arsenide option (Author)

A81-37025 Incidence factors of the tracking systems used in parabolic-cylindrical concentrators A Thomas (Indian Institute of Science, Bangalore, India) *Indian Institute of Science, Journal, Section A - Engineering and Technology*, vol 62, Nov 1980, p 213-219

Several orientation and tracking systems employed in parabolic-cylindrical concentrators for focusing the direct solar radiation on the absorber tubes are analyzed from the technical and economic points of view Case one, where the incidence factor was a function of declination and hour angle, showed that the maximum variations of incident factor from morning to noon was 0.5 at zero angle of declination Case two, where the incidence factor was a function of declination, hour angle and latitude, showed the maximum variation of the incidence factor to be 0.128, which occurred during noon at the latitude of 30 degrees, corresponding to a change of declination from 0 to 23.5 degrees In case three, the incidence factor, a function of declination only, showed that the maximum variation of the incidence factor corresponding to the change in declination from 0 to 23.5 degree was 0.0758 It is concluded that system three is the most efficient from the technical and economic point of view E B

A81-37068 Optical and structural properties of black molybdenum photothermal converter layers deposited by the pyrolysis of Mo(CO)₆-asterisk E E Chain, K Seshan, and B O Seraphin (Arizona, University, Tucson, Ariz) *Journal of Applied Physics*, vol 52, Mar 1981, p 1356-1362 34 refs Research supported by the U S Department of Energy

Black molybdenum thin films, combining high infrared reflectance with significant solar absorptance, have been prepared by pyrolyzing Mo(CO)₆ under oxidizing conditions and subsequent annealing under a hydrogen atmosphere X-ray and electron diffraction, electron microprobe, and Auger analysis show that the films, as deposited, are fine grained (300 Å), stress-free, monoclinic MoO₂ with 010 preferred orientation As the annealing progresses the reflectance in the infrared rises faster than in the visible Consequently, the spectral selectivity can be optimized in a partially annealed state characterized by a complex mixture of Mo and MoO₂ Like black chrome, black molybdenum is a composite material, consisting of metal particles suspended in an oxide matrix However, black molybdenum is capable of prolonged operation at temperatures in excess of the decomposition temperature of black chrome After passivation with Si₃N₄, very simple photothermal solar converter coatings with a respectable spectral selectivity and significant temperature durability at 500 C in vacuum are obtained (Author)

A81-37081 Numerical analysis of junction-depth effect in the grating-type Si solar cell H L Hwang, D C Liu, J E Lin, and J J Loferski (National Tsinghua University, Hsinchu, Nationalist China) *Journal of Applied Physics*, vol 52, Mar 1981, p 1548-1551 8 refs National Science Council of Nationalist China Contract No 69E 0404 03(03)

Numerical simulations are used to analyze the performance of Si grating cells The alternating direction implicit method is used to solve the two-dimensional diffusion equations For a fixed grating geometry, the optimum junction depth is determined The performance of the deep junction grating cells is contrasted with that of the more common shallow-junction cells The results show that the performance of the cells is enhanced both by incorporating a back-surface field and minority-carrier mirrors into the grating structure (Author)

A81-37088 An evaluation of potentially low cost silicon substrates for metal insulator-semiconductor solar cells W A Anderson and G Rajeswaran (New York, State University, Amherst, N Y) *Journal of Applied Physics*, vol 52, Mar 1981, p 1597-1599 8 refs Research supported by the U S Department of Energy

Cr metal insulator semiconductor solar cells were fabricated on special silicon substrates identified as 5 in diam Czochralski wafers, Wacker polycrystalline-Si, silicon on ceramic, and IBM ribbon These cells produced open circuit voltages ranging from 0.58 to 0.48 V, short circuit current density from 32 to 18 mA/sq cm, and efficiency from 11.5 to 5.1% depending on surface perfection and diffusion

length Spectral response data gave diffusion length values in a range from 150 to 39 microns Calculations showed interface state density values ranging from 4.2×10 to the 12th to 1.2×10 to the 13th/sq cm eV, which are quite high due to the surface nature of these substrates (Author)

A81-37090 Characteristics, of GaAs anodic oxide metal-oxide semiconductor solar cells P Das, S N Chakravarti, and K N Bhat (Rensselaer Polytechnic Institute, Troy, N Y) *Journal of Applied Physics*, vol 52, Mar 1981, p 1605-1607 8 refs Grant No AF-AFOSR-77-3426, Contract No N00014 75 C 0772

Metal oxide-semiconductor solar cells with reproducible photo voltaic characteristics have been fabricated on n(+) GaAs substrates employing an oxidation technique which combines an aqueous anodization method with a post-fabrication HCl treatment The cell typically displays an open circuit voltage of the order of 0.59 V and a short circuit current density of 13.65 mA/sq cm under simulated AM1 illumination An efficiency of 5.7% has been achieved without antireflection coating (Author)

A81-37111 Influence of thin metal as a top electrode on the characteristics of P-I-Na Si solar cells M-K Han, W A Anderson, R Lahri (New York, State University, Amherst, N Y), and J Coleman (Plasma Physics Corp, Locust Valley, N Y) *Journal of Applied Physics*, vol 52, Apr 1981, p 3073-3075 8 refs Contract No XS 9 8041 9

Experimental and theoretical analyses of photovoltaic performance in hydrogenated amorphous silicon p n junction solar cells as a function of resistivity, optical transmittance, and work function of thin metal films are presented 30-100 angstroms of various metals (Pd, Cr, Ag, Au, Cu) are deposited to make a semitransparent, highly conductive Ohmic contact for P-I-N and N-I-P cells Photovoltaic measurements are performed under AM1 illumination at room temperature It is shown that metal work function changes the effective built-in potential of p n junction diodes A lower work function metal forms a good Ohmic contact for substrate P(+) - I N(+) electrode cells, and high work function metals improve open-circuit voltage of substrate N-I-P cells Typical open-circuit voltage values are 760 mV with Cr, Cu, and Al N-I-P stainless steel, 700 mV with Pd N-I-P stainless steel, 600 mV with Pd P-I-N stainless steel, and 540 mV with Cr P-I-N stainless steel The short-circuit current is strongly dependent on transmittance and resistivity of the metal films, but the fill factor is independent of the choice of the top electrode An efficiency of 2% has been obtained on a 2-sq cm solar cell K S

A81-37112 Plasma Si nitride - A promising dielectric to achieve high-quality silicon MIS/IL solar cells R Hezel and R Schorner (Erlangen Nurnberg, Universitat, Erlangen, West Germany) *Journal of Applied Physics*, vol 52, Apr 1981, p 3076-3079 20 refs

A low-temperature plasma-enhanced CVD (PECVD) Si nitride was used as a dielectric for MIS/IL solar cells No significant degradation of the MIS contacts occurred due to the plasma deposition at temperatures of up to 300 C, which was the basic requirement for reducing the cell fabrication to a simple one mask photolithographic process It was demonstrated that the PECVD Si nitride has all the properties which are indispensable for the achievement of high quality MIS/IL solar cells the highest positive interface charges densities ever used for this type of a solar cell (up to 7.2×10 to the 12th/sq cm), absolute stability of the charges up to the nitride deposition temperature (220 and 300 C, respectively), excellent passivation of the entire cell, and good AR coating properties High UV sensitive MIS/IL solar cells were fabricated with these layers on p Si (100), and AM1 efficiencies of 15% (active area) at 25 C were obtained K S

A81-37261 Indium doped cadmium sulfide films deposited by cylindrical magnetron reactive sputtering J A Thornton, D G Cornog (Telic Corp, Santa Monica, Calif), and W W Anderson (Lockheed Research Laboratories, Palo Alto, Calif) (*American Vacuum Society, National Symposium, 27th, Detroit, Mich, Oct 13-17, 1980*) *Journal of Vacuum Science and Technology*, vol 18, Mar 1981, p 199-202 32 refs Contracts No XJ 9 8033-1, No XJ 9 8033-2

Cadmium sulfide coatings about 500 nm thick are deposited by reactive sputtering onto borosilicate glass substrates at temperatures

in the range 150-350 °C using pure and In-doped Cd cylindrical magnetron sputtering sources. The working gas is Ar/H₂S with various H₂S injection rates. Deposition rates are approximately 1 nm/sec. Adatom desorption is found to limit the cadmium sulfide accumulation rate to the extent to which the Cd can interact with the S to produce CdS. As a consequence, the undoped deposits are nearly stoichiometric, with resistivities of approximately 10,000 ohm cm. The resistivities of the doped coatings are found to be critically dependent on the H₂S injection rate, apparently because of compensation by Cd vacancies. Resistivities in the range 0.1-5.0 ohm cm, suitable for Cu₂S/CdS solar cells, are obtained for target doping levels of 0.1-1.0 at % when the deposition flux is rich in Cd. Higher H₂S injection rates are found to yield resistivities in the range of 1000 ohm cm. Electron Hall mobilities range from 2 to 15 sq cm/V-sec in the doped CdS to 20 sq cm/V-sec in the undoped material. (Author)

A81-37262 Anti-reflection coatings for thin-film polycrystalline CdS/Cu₂S solar cells. J. A. Bragnolo and L. C. DiNetta (Delaware, University, Newark, Del.) (*American Vacuum Society, National Symposium, 27th, Detroit, Mich., Oct. 13-17, 1980*) *Journal of Vacuum Science and Technology*, vol. 18, Mar. 1981, p. 364-367. 9 refs.

Single and double layer thin-film anti-reflection (AR) coatings have been designed and applied to CdS/Cu₂S solar cells. A variety of materials, such as SiO₂, Ta₂O₅, TiO₂, ZnS, MgF₂, and SiO₂ have been deposited by sputtering and vacuum deposition, both reactive and nonreactive. The absorption of the resulting AR films was found to be less than 0.01 for practical film thicknesses. Total cell reflectance, measured with a Gier-Dunkle SP 220 integrating sphere, as well as light generated current data were used to optimize the AR coating design and deposition. Optical losses were found to be weakly dependent on the AR material or design and strongly dependent on Cu₂S texture. The results are analyzed in terms of a simple planar multilayer model. (Author)

A81-37263 Surface and interface properties of Zn₃P₂ solar cells. L. L. Kazmerski, P. J. Ireland (Solar Energy Research Institute, Golden, Colo.), and A. Catalano (Delaware, University, Newark, Del.) (*American Vacuum Society, National Symposium, 27th, Detroit, Mich., Oct. 13-17, 1980*) *Journal of Vacuum Science and Technology*, vol. 18, Mar. 1981, p. 368-371. 18 refs.

The compositional properties of Zn₃P₂ thin films are studied using surface analysis techniques. Relative sensitivity factors of S(Zn sub LMM) = 0.29 and S(P sub LMM) = 0.34 are determined for this semiconductor with the aid of Auger electron spectroscopy standard spectra. The interfacial properties of the Mg/Zn₃P₂ thin-film solar cell are studied using Auger electron spectroscopy depth-compositional profiling in conjunction with complementary secondary ion mass spectroscopy and X-ray photoelectron spectroscopy data. Evidence is adduced for the formation of Mg₃P₂ at the metal semiconductor interface. It is noted that this compound has a bandgap near that of Zn₃P₂. Attention is given to the possible formation of a heterojunction as a result of the interfacial reaction. (Author)

A81-37265 Sputtered iron oxide/silicon heterostructures. M. J. Kardauskas, S. J. Fonash, S. Ashok, S. V. Krishnaswamy, and R. F. Messier (Pennsylvania State University, University Park, Pa.) (*American Vacuum Society, National Symposium, 27th, Detroit, Mich., Oct. 13-17, 1980*) *Journal of Vacuum Science and Technology*, vol. 18, Mar. 1981, p. 376-378. 5 refs. Research supported by the U.S. Department of Energy.

Sputtered Fe₃O₄ films are shown to form rectifying junctions to p-type silicon but ohmic contacts to n-type Si. It is pointed out that ohmic contacts to the Fe₃O₄ can be provided by Au, Al, or spray deposited ITO. The redox couple Fe(CN)₆(3-)/Fe(CN)₆(4-) also seems to make an effective ohmic contact to this iron oxide. It is found that the photovoltaic and electrical characteristics of the Fe₃O₄/p-Si heterojunction depend strongly on the Fe₃O₄ film thickness. (Author)

A81-37266 Photodesorption studies of CO and CO₂ from the solar absorber black chrome. G. Zajac, A. Ignatiev (Houston, University, Houston, Tex.), and G. B. Smith (Houston, University, Houston, Tex., New South Wales Institute of Technology, Broadway,

Australia) (*American Vacuum Society, National Symposium, 27th, Detroit, Mich., Oct. 13-17, 1980*) *Journal of Vacuum Science and Technology*, vol. 18, Mar. 1981, p. 379-381. 16 refs. Research supported by the U.S. Department of Energy and University of Houston.

Photodesorption of CO and CO₂ has been studied on black chrome solar absorbing coatings. It is shown that the desorption is a quantum effect with possible basis in the photo-hole model application to semiconductor surfaces, but with yields similar to that reported for photodesorption from metals. (Author)

A81-37267 Enhanced interdiffusion of Cu into RF-sputtered chromium oxide films. S. V. Krishnaswamy, L. L. Tongson, N. Said, and R. Messier (Pennsylvania State University, University Park, Pa.) (*American Vacuum Society, National Symposium, 27th, Detroit, Mich., Oct. 13-17, 1980*) *Journal of Vacuum Science and Technology*, vol. 18, Mar. 1981, p. 401-404. 12 refs. Contract No. EM 78 C 04 5302.

The interdiffusion of chromium oxide films RF-sputtered in O₂ ambient onto substrates of bulk Cu as well as approximately 100 nm thin films of Cu was studied using Auger electron and ion scattering spectrometries. Composition depth profiling was carried out for films deposited on substrates which were untreated, thermally oxidized, and plasma oxidized and had other surface pretreatments. Interdiffusion of Cr₂O₃ films with bulk and thin film Cu substrates is observed even in unannealed samples and increases with annealing treatment. Essentially complete intermixing of Cu and Cr occurred upon annealing at 150 °C for the Cr₂O₃/Cu film couple. Such layers are potential selective solar absorber coatings. (Author)

A81-37312 Device quality epitaxial AlAs by metalorganic-chemical vapor deposition. J. J. Coleman, P. D. Dapkus (Rockwell International Electronics Research Center, Anaheim, Calif.), N. Holonyak, Jr., and W. D. Laidig (Illinois, University, Urbana, Ill.) (*Applied Physics Letters*, vol. 38, June 1, 1981, p. 894-896. 19 refs. NSF Grant No. DMR-79-09991, Contract No. N00014-78-C-0711).

The growth and characterization of high quality AlAs epitaxial layers on GaSb substrates by metalorganic-chemical vapor deposition are described. The epitaxial layers described here are grown at intermediate temperatures (750 °C) and require no unusual reactor modifications. Comparison is made between single thick epitaxial layers and an 80 layer quantum well heterostructure. Low-threshold photopumped laser data are presented, which indicate that the presence of AlAs in the active region of a laser (containing 80 AlAs-GaSb interfaces) does not interfere with CW room temperature operation. (Author)

A81-37313 Schottky-barrier profile in silicon alloys. T. Datta and M. Silver (North Carolina, University, Chapel Hill, N.C.) (*Applied Physics Letters*, vol. 38, June 1, 1981, p. 903-905. 7 refs. NSF Grant No. DMR 79 20023, Grant No. DAAG29 77 G 0081).

A new approach is presented for the determination of the potential profile. The approach makes use of a photoconductive null method to measure the forward bias pulse voltage which produces a zero photocurrent at various pulse laser wavelengths. The new technique has been applied to Si-F-H alloys. The laser pulse was normally applied either 0.5 or 1 microsecond after the forward bias-voltage pulse. Data obtained for longer delays show the modification of the space charge under forward bias. Other measurements were conducted under a steady background tungsten lamp illumination to determine the effect of illumination on the space-charge field. Two independent delay generators are employed to trigger the laser and the transient digitizer sweep. (Author)

A81-37315 Optical absorption coefficients from short-circuit current measurements of solar cells. B. M. Basol (California, University, Los Angeles, Monosolar, Inc., Santa Monica, Calif.) and O. M. Stafsudd (California, University, Los Angeles, Calif.) (*Applied Physics Letters*, vol. 38, June 1, 1981, p. 918, 919. 6 refs.).

A technique is described to determine the optical absorption coefficients of semiconductor films. This technique uses the spectral response of solar cells formed on these films. Under certain conditions the photogenerated current in a back-wall solar cell is a simple exponential function of the absorption coefficient and the thickness of the device. As a result the optical absorption coefficients can be obtained from the slopes of log(I) versus thickness curves at

different wavelengths. The technique was applied to electrochemically deposited CdTe and gave results that are in agreement with other published work. (Author)

A81-37316 Thin-film polycrystalline Cu₂S/Cd_{1-x}Zn_xS solar cells of 10% efficiency R B Hall, R W Birkmire, J E Phillips, and J D Meakin (Delaware, University, Newark, Del.) *Applied Physics Letters*, vol 38, June 1, 1981, p 925, 926 5 refs. Research supported by the U S Department of Energy

Polycrystalline, thin-film Cu₂S/Cd_{1-x}Zn_xS heterojunction solar cells with conversion efficiencies of 10% have been prepared on Cd_{1-x}Zn_xS with x in the range 0.1-0.2. High-generated currents of up to 26 mA/sq cm (prorated to 100 mW/sq cm) have been achieved, comparable to the best observed in Cu₂S/CdS cells of the same design. The improved performance for Cu₂S based devices is as a consequence of the higher open-circuit voltage achieved with the addition of zinc. (Author)

A81-37321 Efficiency losses from carrier-type inhomogeneity in tungsten diselenide photoelectrodes S Menezes, L F Schneemeyer, and H J Lewerenz (Bell Telephone Laboratories, Inc., Murray Hill, N J.) *Applied Physics Letters*, vol 38, June 1, 1981, p 949-951 8 refs

The coexistence of macroscopic p- and n-type domains in nominally smooth, single crystal tungsten diselenide photoelectrodes leads to substantial efficiency losses in these crystals. The presence of such regions is demonstrated by rotating disk electrode experiments, Seebeck coefficient measurements, and in situ topographic photo-generated carrier collection analysis with a scanning laser spot. These results indicate the importance of controlling growth parameters to yield homogeneously doped crystals to achieve maximum solar conversion efficiencies. (Author)

A81-37345 Seasonal storage of energy in solar heating J E Braun, S A Klein, and J W Mitchell (Wisconsin, University, Madison, Wis.) *Solar Energy*, vol 26, no 5, 1981, p 403-411 18 refs

This paper focuses on several aspects of seasonal storage for space heating using water as the storage medium. The interrelationships between collector area, storage volume, and system performance are investigated using the transient simulation program TRNSYS. The situations for which seasonal storage is most promising are presented. Particular emphasis is placed upon design of seasonal storage systems. A design method is presented which is applicable for storage capacities ranging from a few days to seasonal storage. This design method, coupled with cost information, should be useful in assessing the economic viability of seasonal storage systems. Also investigated are the importance of the load heat exchanger size, tank insulation, collector slope, and year to year weather variations in system design. (Author)

A81-37346 A simplified method for estimating the monthly-average performance of photovoltaic systems M D Siegel, S A Klein, and W A Beckman (Wisconsin, University, Madison, Wis.) *Solar Energy*, vol 26, no 5, 1981, p 413-418 14 refs. Research supported by the U S Department of Energy

A method is presented for estimating the monthly average conventional energy displaced by photovoltaic systems. Monthly-average array efficiency is estimated in terms of array parameters and monthly average meteorological data. Monthly-average excess capacity is estimated for systems having a constant load during daylight hours. If the system does not have battery storage, excess capacity must be dissipated or fed back to the utility. With battery storage, a portion of the excess capacity can be stored for later use. A method is presented for estimating the monthly average system performance for a constant 24 hr-per day load with a battery of specified capacity. (Author)

A81-37347 Solar cell interconnections and the shadow problem J Feldman (Tel Aviv University, Tel Aviv, Israel, North eastern University, Boston, Mass.), S Singer, and A Braunstein (Tel Aviv University, Tel Aviv, Israel) *Solar Energy*, vol 26, no 5, 1981, p 419-428 5 refs

The problem of a regular shadow moving across a terrestrially based solar cell array is discussed. It is shown that by use of a non regular (pseudo random) interconnection scheme, it is possible to electrically distribute the impact of the shadow and thus obtain

substantially higher average output power. This result applies a fortiori to arrays subjected to dust and appears to apply as well to arrays prone to localized damage. Two regular arrays and eight pseudo random arrays are considered in detail. Each comprises 40 rows of 10 parallel cells each. Improvements of 30-40 per cent are typical, with several more spectacular examples. For regular shadows in a terrestrial application, the pseudo random interconnection scheme gives substantially greater output than the more conventional shunt-diode methodology. (Author)

A81-37447 The selective absorption of solar radiation by a metal-dielectric tandem with rough interfaces (Sur l'absorption selective du rayonnement solaire par un tandem metal dielectrique a interfaces rugueuses) A Wirgin (Paris VI, Université, Paris, France) *Académie des Sciences (Paris), Comptes Rendus, Serie II - Mécanique, Physique, Chimie Sciences de l'Univers, Sciences de la Terre*, vol 292, no 13, Mar 30, 1981, p 945-948 6 refs. In French

The effects of the roughness at the air dielectric interface induced by a rough metal dielectric interface in a photothermal solar collector are considered. A nonrigorous theory of periodic roughnesses of small amplitude on both interfaces is developed for the case of a structure illuminated by a plane wave, and shown to be in agreement with the rigorous theory of Botten (1978) for the case of roughness only at the metal dielectric interface. Extension to the case of roughness at both interfaces indicates that the replication of the roughness at the air dielectric interface leads to a decrease in the absorptivity of the structure with respect to that with a planar interface. A L W

A81-37563 Solar energy collection by the tower system T Taguchi and M Takemoto (Mitsubishi Heavy Industries, Ltd., Hiroshima Technical Institute, Hiroshima, Japan) *Energy Developments in Japan*, vol 3, Jan 1981, p 247-254. Translation

Solar energy collecting tests were carried out under Japan's Sunshine Project, as part of the solar thermal electric power system. The total mirror area of the heliostats was increased by a factor of three to 300 sq m, making the dimensional ratio between the tower height and field diameter equivalent to that of the pilot plant, as well as achieving a similar heat flux magnitude as the pilot plant. The absorbing efficiency of the No. 4 receiver was studied and proven to be inferior to the No. 7 receiver, with its improved wind shield cavity, reducing reflection losses at higher wind velocities. The difference in convection heat losses between the two receivers in the solar energy collecting apparatus did not, however, directly correspond to the difference between them measured in the pilot plant. Thus, a heat loss test was applied to the No. 7 receiver, and fluctuations in the measured values of absorbing efficiencies were shown to be due to fluctuations of convection heat loss. Future plans include the design of external receivers suitable for low towers, with a lighter weight and a greater compactness for minimum heat loss potential. J F

A81-38122 * Photovoltaics J L Smith (California Institute of Technology, Jet Propulsion Laboratory, Photovoltaic Lead Center, Pasadena, CA) *Science*, vol 212, June 26, 1981, p 1472-1478 13 refs

The federal government has sponsored a program of research and development on terrestrial photovoltaic systems that is designed to reduce the costs of such systems through technological advances. There are many potential paths to lower system costs, and successful developments have led to increased private investment in photovoltaics. The prices for photovoltaic collectors and systems that appear to be achievable within this decade offer hope that the systems will soon be attractive in utility applications within the United States. Most of the advances achieved will also be directly applicable to the remote markets in which photovoltaic systems are now commercially successful. (Author)

A81-38171 On the thermodynamic limit of photovoltaic energy conversion A De Vos and H Pauwels (Gent, Rijksuniversiteit, Ghent, Belgium) *Applied Physics*, vol 25, June 1981, p 119-125 13 refs

An infinite stack of p-n junctions with smoothly varying bandgap from infinity to 0 is considered. An I-V characteristic is derived which is more correct than the classical exponential characteristic. It is shown that open circuit operation is a reversible

process and leads to the Carnot efficiency, if one defines the efficiency in the way that is usual in the theory of thermodynamic engines. If instead one uses the definition of efficiency usual in photovoltaics, the open circuit mode gives rise to zero efficiency. Then operation at maximum efficiency equals operation at maximum power and is not reversible. (Author)

A81-38183 Solar radiation in Lebanon. A. A. Sfeir. *Solar Energy*, vol 26, no 6, 1981, p 497-502. 15 refs. Research supported by the Ecole Nationale des Travaux Publics de l'Etat, American University of Beirut, and Conseil National de la Recherche Scientifique.

Solar radiation data for two sites in Lebanon are analyzed and presented in a form suitable for their use by practicing engineers. Correlations of the Angstrom Page type for daily and monthly data are developed. Probability density functions for daily values of global radiation for each month are compared with the results of Liu and Jordan. The atmospheric model developed by Cole and extended by Barbaro et al. is found to predict monthly average global radiation with acceptable accuracy and is therefore recommended for extending the data at other sites of the country. (Author)

A81-38184 Planar concentrators for flat-plate solar collectors. H. F. Chiam. (Commonwealth Scientific and Industrial Research Organization, Div. of Mechanical Engineering, Highett, Victoria, Australia). *Solar Energy*, vol 26, no 6, 1981, p 503-509. 9 refs. Research supported by the Department of National Development of Australia.

A systematic study has been made of the effectiveness of planar specular reflectors for solar energy collectors. Two daily averaged indices of performance were used. One, the area ratio, indicates the amount by which the reflector extends the effective receiver area. The other is the enhancement factor, which is used to compare the energy received by an augmented collector with that by a reference collector at optimum tilt. A reflector can be mounted either above or below a flat-plate collector. Both combinations are evaluated fully, by varying separately the angular position and dimensions of the reflector and of the collector. The principal parameters are identified and the main characteristics summarised as a series of performance curves. These curves provide an easy method for determining optimum reflector geometries. Use of the performance curves may be extended to obtain the configuration of the two reflectors in a trough concentrator. This also allows the single-reflector system to be compared directly with the trough concentrator. Evidence is presented which shows the advantages of an asymmetrical trough configuration over a symmetrical concentrator. (Author)

A81-38185 Apparatus for total hemispherical emittance measurements of full scale receiver pipes from 100 to 300 C. T. A. Reitter. (California, University, Livermore, CA) and W. H. Giedt. (California, University, Davis, CA). *Solar Energy*, vol 26, no 6, 1981, p 511-518. 16 refs. Contract No. W-7405-eng-48.

An apparatus is described for measuring the total hemispherical emittance of pipes of a length suitable for use in a prototype solar collector. The calorimetric method used requires measurements of the temperatures of the surface of the test pipe and of a concentric outer cylinder and measurement of the electrical power used to heat the test pipe. Measurements were made of the total hemispherical emittance of black chrome, nickel, and bare steel pipes as a function of temperature. The emittance of the black chrome surfaces increased significantly from an extrapolated value of about 0.1 at 25 deg C to values on the order of 0.3-0.4 at 300 deg C. The extrapolated values for black chrome agreed with measurements made using other techniques at room temperature. The results for the nickel-plated pipe agreed with total emittance calculated from spectral reflectance data. (Author)

A81-38186 Optical evaluation of cylindrical elastical concentrators. P. G. McCormick. (Western Australia, University, Nedlands, Australia). *Solar Energy*, vol 26, no 6, 1981, p 519-523. 8 refs. Research supported by the Solar Energy Research Institute of Western Australia.

A study of elastica profiles formed by the elastic buckling of sheet reflectors and the application of such profiles to cylindrical concentrating collectors has been carried out using a ray trace

analysis. Maximum concentration ratios of approx 6 are obtained using untruncated elastica profiles. Edge truncation of the reflector substantially increases the maximum concentration ratio. Truncation of the centre of the reflector is shown to provide a method for obtaining a uniform flux distribution on the receiver. (Author)

A81-38188 Local storage of solar energy by reversible reactions with sulfates. M. Tmar, C. Bernard. (Grenoble, Ecole Nationale Supérieure d'Electrochimie et d'Electrometallurgie, Saint-Martin-d'Hères, Isère, France), and M. Ducarroir. (CNRS, Laboratoire des Ultra Refractaires, Odeillo, Pyrénées Orientales, France). *Solar Energy*, vol 26, no 6, 1981, p 529-536. 19 refs. Centre National de la Recherche Scientifique Contract No. ATP-3856-2.

The problem of the storage of solar energy is of prime importance. Among the possibilities for thermal storage, the use of the heat of a reversible reaction seems to be very attractive because of its high energetic content. In 1961 Goldstein proposed such a method and more recently Wentworth (1976) has reviewed many simple stoichiometric decomposition reactions in terms of their reversal temperature. In this paper the authors study the possibilities offered by the decomposition of the sulfates of Mg-Al-Fe-Co-Ni-Cu and Zn in different processes to store solar energy: hot and cold storage with SO₂-O₂ or SO₃ are considered. In addition, an exergy ratio is defined in order to classify the various sulfates. Finally as an example, a determination of the amount of the storage medium is presented for the case of NiSO₄. (Author)

A81-38191 A simplified method for calculation of concentration characteristics of a solar tower system. L. Y. Wei. (Waterloo, University, Waterloo, Ontario, Canada). *Solar Energy*, vol 26, no 6, 1981, p 559-562.

Riaz (1976) has provided a theory that uses closed-form formulas for analyzing radiation and shading relations in the case of a heliostat system concentrating sunlight onto a central receiver. In the considered investigation a simplified method is developed for the same purpose. The integral used by Riaz is replaced by a summation series in which the number of terms is of the order of the number of heliostat mirrors. By combining terms of similar nature, the length of the series can be reduced for a simplification of the calculation. A suitable representation 'O' point is determined for each group of mirrors in the array. This approach is called 'O' point representation or 'equivalent circle representation'. G. R.

A81-38192 Shading effects of collector rows tilted toward the equator. R. E. Jones, Jr. and J. F. Burkhart. (Colorado, University, Colorado Springs, CO). *Solar Energy*, vol 26, no 6, 1981, p 563-565. 7 refs.

In the design of solar energy systems for which a close spacing of the rows of collectors must be considered, it is important to determine accurately shadow effects which will reduce the radiation flux for the collectors. A description is presented of an analytical model for calculating the daily total radiation on rows of fixed collectors tilted toward the equator. The model is an extension of a model reported by Liu and Jordan (1961). The shading plane concept introduced by Jones (1980) is employed. In order to utilize the shading plane method it is necessary to invoke the restriction that the length of the row be very long in comparison with the other system dimensions. Attention is given to full beam radiation exposure, partial beam radiation exposure, overall beam radiation, the shading of diffuse radiation, the total average irradiation of shaded collectors, and example calculations. G. R.

A81-38264 # Heliostat characterization at the Central Receiver Test Facility. D. L. King and D. E. Arvizu. (Sandia Laboratories, Albuquerque, NM). *ASME, Transactions, Journal of Solar Energy Engineering*, vol 103, May 1981, p 82-88. 9 refs. Research sponsored by the U. S. Department of Energy.

The Central Receiver Test Facility (CRTF) operated for the Department of Energy by Sandia Laboratories in Albuquerque, NM was constructed for the purpose of evaluating solar central receiver design concepts. At this facility working experience with the CRTF heliostat field has been gained and an extensive heliostat evaluation capability has evolved. Valuable information has been gained at the CRTF that will help in the future design and specification of heliostats. This paper summarizes the work that led to the current state of heliostat evaluation capability and includes a description of

the CRTF heliostat, measurements of environmental degradation of mirror reflectance, heliostat beam measurements with an instrumented sweeping bar, beam quality and tracking accuracy data obtained with the newly developed Beam Characterization System (BCS) and comparisons of measured beam data with the heliostat computer model HELIOS (Author)

A81-38265 # Optimal control of mass flow rates in flat plate solar collectors. R C Winn and C B Winn (Colorado State University, Fort Collins, CO) *ASME, Transactions, Journal of Solar Energy Engineering*, vol 103, May 1981, p 113-120 10 refs Contract No EG 77-S-02 4519

The optimal flat plate collector fluid flow rate is determined for several combinations of objective functions and system models. The method of implementing the control strategy for one of the problems considered, that which maximizes the integral of the difference between the collected solar power and fluid moving power, is described. The performance of the solar energy collection system in Solar House II at Colorado State University using this optimal controller is discussed and compared with the same system using bang-bang control. In addition, the dependence of the collector efficiency factor on flow rate is considered and its effect on the optimal control is determined (Author)

A81-38267 # Uncertainty in determining thermal performance of liquid-heating flat-plate solar collectors. E R Streed and D Waksman (National Bureau of Standards, National Engineering Laboratory, Washington, DC). *ASME, Transactions, Journal of Solar Energy Engineering*, vol 103, May 1981, p 126-134 15 refs Research supported by the U S Department of Energy

Thermal performance measurements of eight types of liquid-heating flat-plate solar collectors were conducted with two to four collectors of each type at four outdoor test sites. Tests were performed in accordance with the procedure prescribed by ASHRAE Standard 93-77. Statistical analysis of data sets for each collector type within test sites and between test sites was done using ASTM recommended methods to evaluate test method measurement uncertainty (Author)

A81-38268 # Effect of corrugated cover directional transmittance on the thermal performance of a solar collector. T F Smith and S Chaidar (Iowa, University, Iowa City, IA). *ASME, Transactions, Journal of Solar Energy Engineering*, vol 103, May 1981, p 144-152 12 refs

The benefits of light weight, structural strength, and reduced costs without significant reduction of transmission of solar energy of a corrugated fiberglass composite cover promise wide utilization of this cover in solar collectors to suppress convective and radiative heat losses from the absorber panel. In order to evaluate the thermal performance of a collector with a corrugated cover, the directional transmittance of the cover must be available. A study was undertaken to develop a model for the directional transmittance of a corrugated cover as represented by a sinusoidal periodic function. As an application of this model, hourly and daily thermal efficiencies of a solar collector with a corrugated cover are presented (Author)

A81-38270 # Natural convection and sidewall losses in trapezoidal groove collectors. L Iyican (Shell Development Co., Houston, TX), L C Witte (Houston, University, Houston, TX), and Y. Bayazitoglu (Rice University, Houston, TX). *ASME, Transactions, Journal of Solar Energy Engineering*, vol 103, May 1981, p 167-172 11 refs NSF Grant No ENG-77-01422

Experimental data for heat transfer across air-filled inclined trapezoidal enclosures are reported for a Rayleigh number range of approximately 2×10^5 to the 3rd to approximately 5×10^5 to the 7th. The large side was cooled to uniform temperature while the opposing small side was electrically heated. The enclosures were completed by two aluminum sidewalls which simulated the reflective surfaces in moderately-concentrating solar collectors. The experiments show that conductive heat losses up the sidewalls can be very large even when the sidewalls are thermally insulated from the top and bottom surfaces. However, the conductivity of the sidewalls has only a small effect on convective heat transfer across the groove. Natural convection heat transfer in the groove can be correlated reasonably well by an equation of the form $Nu = C Ra \exp 0.345$ (Author)

A81-38324 The photovoltaic Cu₂S CdS process (La filière photovoltaïque Cu₂S-CdS). M Savelli and J Bougnot (Montpellier II, Université, Montpellier, France). *L'Onde Electrique*, vol 61, Apr 1981, p 29 33 11 refs In French

Recently developed processes for the fabrication of thin-film Cu₂S CdS photovoltaic solar cells are examined. The principal techniques for the preparation of thin films of cadmium sulfide and cuprous sulfide are indicated, including vacuum evaporation, cathodic spraying and chemical spraying for the former and wet chemical reactions, evaporation and annealing, vacuum evaporation, and chemical spraying for the latter, and the heat treatments employed for the fabrication of the Cu₂S CdS heterojunctions for front- and back-illuminated solar cell structures are considered. Results obtained by various groups working on the industrial production of Cu₂S CdS cells based on evaporated or chemically sprayed CdS and Cu₂S obtained by immersion in a CuCl solution are presented, and it is noted that CdS evaporation techniques have been found to lead to higher cell efficiencies although the spraying method is more economical. French organizations currently involved in research on Cu₂S CdS processes are then surveyed, and the performances of photovoltaic structures obtained by a process involving chemical spraying are examined in detail, noting test results of a peak efficiency of 7.4 percent for a 1-sq cm surface under AM1 illumination SCS

A81-38331 A study on optimal power delivery from a photovoltaic generator by use of a microprocessor (Recherche de la puissance optimale délivrée par un générateur photovoltaïque à l'aide d'un dispositif microprogrammé). M Barlaud, D Pradal, and J P Requier (Dakar, Université, Dakar, Senegal). *Entropie*, vol 16, no 95, 1980, p 41-44 In French

An algorithm developed to locate the optimum power delivery from a photovoltaic generator is presented. The solar module is considered as a dipole with nonlinear static characteristics, with a dc/dc and dc/ac static converter intercalated between generator and load, and the goal was to improve chopper performance and reduce residual oscillations. A microprocessor governed by the algorithm, controlling a multiplexer and a digital-analog converter, measures load and current and calculates power, searching for convergence of converter function where power delivery is maximized. Load oscillations on the generator are shown to increase as demand decreases, the system reads divergence from a previous maximum power level and augments an incremental return to the peak level, varying with the load. An application to an 8 W module in Dakar insolation, with a 20 ohm resistance and a chopper functioning at 1 kHz, is given, with response time centering around 15 ms. The system is noted to have been successfully used in heat engines and wind powered generators D H K

A81-38463 Stability of aluminium-polysilicon photovoltaic junctions. D J Thomson, M A Matkowsky, and H C Card (Manitoba, University, Winnipeg, Canada). *Electronics Letters*, vol 17, May 28, 1981, p 382, 383 9 refs. Natural Sciences and Engineering Research Council of Canada Grant No G 0442

Aluminum p-type polysilicon contacts display a rectifying behavior which exhibits an aging towards reduced Schottky barrier heights and increased n-values or ideality factors. The time scale for this aging process increases dramatically with the thickness of the aluminum layer in the range 100-1000 Å, and the overall behavior is in accordance with the model of Ponpon and Siffert for transport of oxygen through the aluminium film to the polysilicon surface (Author)

A81-38483 Silicon photovoltaic cells. R N Hall (General Electric Co., Schenectady, NY). *Solid-State Electronics*, vol 24, July 1981, p 595 616 121 refs

The principles governing the performance of silicon solar cells are reviewed with emphasis on clarifying the essential concepts. Principal attention is devoted to the planar p-n junction cell and recent developments that have contributed to increased efficiency. Other solar cell structures are also reviewed and their relative advantages and shortcomings are discussed. Important areas where our present understanding is inadequate are pointed out and some common misconceptions are corrected (Author)

A81-38510 Solar voltaic cells W D Johnston, Jr (Bell Telephone Electronics Research Laboratory, Holmdel, NJ) New York, Marcel Dekker, Inc (Energy, Power, and Environment Volume 7), 1980 222 p 167 refs \$29 50

Solar energy and energy needs are considered, taking into account U S energy requirements, the U S national photovoltaic program, economic and social implications, and less-developed countries. Basic principles and established technologies are examined, giving attention to crystalline solids, band theory, pn junctions, metal-semiconductor junctions, heterojunctions, an idealized pn junction solar cell, aspects of practical analysis, single or semicrystal Si cells, single-crystal GaAs cells, and CdS/Cu₂S cells. A description of research directions is provided. Projects conducted are concerned with nonconventional silicon, amorphous Si-H alloy cells, a polycrystalline thin III-V thin film cell, alternative semiconductor materials, organic film solar cells, photoelectrolytic hydrogen generation, and pyroelectric generation. Flat-plate modules are considered along with concentrator modules, storage and power conditioning, endurance testing, and the cost impact of balance-of-system elements. G R

A81-38591 * Projected performance of III-V epitaxial multijunction solar cells in space T J Maloney (Varian Associates, Palo Alto, CA) *Solar Energy Materials*, vol 4, Apr-May 1981, p 359-372 16 refs Contract No NAS3-21290

The monolithic epitaxial multijunction stack, to be fabricated from III-V quaternary alloys, has been analyzed for use in space with a detailed computer model. AlGaInAs and AlGaAsSb three junction cells, each having an AlAsSb window, were modeled as functions of temperature, concentration, minority carrier diffusion length, etc., as were AlGaAs/GaAs and AlGaAsSb/InP two junction cells. Cell efficiencies for one expected operating point in space (50 suns, 125 C) were around 20% for the two junction cells and around 23-24% for the three-junction cells, using projected minority carrier diffusion lengths of 1.5 microns. Longer diffusion lengths in the III-V alloys (approaching those of GaAs) would allow the three-junction cells to reach 30% efficiency, if such conditions as 100 suns, 50 C can be achieved. The major technological challenges facing the high-efficiency multijunction cell are summarized and discussed in light of the modeling results. (Author)

A81-38592 The selective solar absorptance of in situ-grown oxide films on metals D L Douglass and R B. Pettit (California, University, Los Angeles, CA, Sandia Laboratories, Albuquerque, NM) *Solar Energy Materials*, vol 4, Apr-May 1981, p 383-402 11 refs

The solar absorptance and emittance were measured for a number of generic oxides grown in situ on a variety of pure metals and alloys. The surface films were formed by reacting the substrates in air, pure oxygen, or high-temperature, high-pressure water to give a range of thickness for each oxide. The oxide/metal systems investigated included ZnO and/or Cu₂O on brass, Cu₂O on Cu 30 Ni, Cu₂O on aluminum bronze and Cu-5 Al, NiO on nickel, TiO₂ on titanium, ZrO₂ on Zircaloy-2, Fe₂O₃ on iron, Fe₂O₃ on type 201 stainless steel, Fe₃O₄ on Kovar, Cr₂O₃ on chromium-coated steel and Al₂O₃ on Kanthal A-1. Optical properties depended markedly on film thickness. Only two oxides, NiO and ZrO₂, had a combination of high solar absorptance (greater than 0.8) and low 100 C emittance (less than 0.3). A third oxide, Cu₂O, had an absorptance of 0.74 and an emittance of 0.25. The oxide films exhibited no tendency to spall. Attempts to rationalize selective solar absorption on theories involving the index of refraction of the films or the band-gap energies were only partially successful. There is little basis for selecting candidate oxides based on physical properties. (Author)

A81-38593 Composition and degradation of graded metal-carbon solar selective absorbing surfaces G L Harding and S Craig (Sydney, University, Sydney, Australia) *Solar Energy Materials*, vol 4, Apr-May 1981, p 413-420 22 refs Research supported by the University of Sydney

An investigation of magnetron sputtered graded stainless steel-carbon on copper solar selective absorbing surfaces by Auger electron spectroscopy is described. The composition of the dielectric layer of these surfaces is shown to be almost pure carbon. Optical measurements and Auger spectroscopy of selective surfaces annealed in a

continuously evacuated furnace has isolated two degradation mechanisms: oxidation of the metal-rich layers of the metal-carbon film, and diffusion of metal components into the copper substrate. Analysis of these results and previous experimental work suggest that this type of selective surface should experience negligible deterioration during the lifetime of a suitably outgassed permanently sealed evacuated collector operating at temperatures below 300 C. (Author)

A81-38594 Thermal conduction in evacuated concentric tubular solar energy collectors degraded by low pressure gas G L Harding and B Window (Sydney, University, Sydney, Australia) *Solar Energy Materials*, vol 4, Apr-May 1981, p 421-434 20 refs Research supported by the University of Sydney

Thermal conduction has been investigated in evacuated concentric glass tubular solar energy collectors degraded by the accumulation of low pressure gas in the annular region. Two different types of dependence of conducted heat flux with temperature difference between absorber tube and envelope have been observed. Experiments on collectors sealed with controlled quantities of known gases indicated that the different temperature dependences are associated with different energies of adsorption of molecules on the collector surfaces. The heat conduction has been modelled theoretically using measured accommodation coefficients and some typical adsorption energies for various molecules. (Author)

A81-38773 Effect of temperature on organic Schottky barrier cells R O Loutfy and C-K Hsiao (Xerox Research Centre of Canada, Mississauga, Ontario, Canada) *Canadian Journal of Physics*, vol 59, June 1981, p 727-732 6 refs Research supported by the National Research Council of Canada

The effect of temperature on the photovoltaic properties of indium/metal-free phthalocyanine Schottky barrier solar cells was investigated in the range 260-350 K. In general, the short circuit photocurrent, and fill factor, increased with increasing temperature (in contrast to inorganic photocells). The device series resistance and open circuit photovoltage decreased (similar to inorganic photocells) as temperature was raised. An increase in the overall power conversion efficiency has been observed with increase of temperature. In the case of x-H₂Pc, the power conversion efficiency increased by 2.5 times due to a temperature rise of 60 C above ambient. Thus, for operation at temperatures above ambient, organic solar cells may offer a significant advantage over inorganic cells. (Author)

A81-38822 Solar photovoltaic power systems - Will they reduce utility peaking requirements R O Mueller, B K Cha, and R F Giese (Argonne National Laboratory, Argonne, IL) *Science*, vol 213, July 10, 1981, p 211-213 11 refs Research supported by the U S Department of Energy

From an analysis of the long run electric generating requirements of several representative utilities, it is concluded that the energy supplied by solar photovoltaic power devices will displace primarily base load, and to a lesser extent intermediate, generating plants, even at relatively modest penetrations corresponding to several percent of the utility peak load. Attaching photovoltaic devices to the utility grid will not yield significant fuel oil savings over the long run, in which utilities approach the economic optimum generating mix, and will increase peak plant requirements. Utility capacity and fuel savings of photovoltaic devices are reported both for the case without storage and for the case in which the utility has access to load-leveling storage. (Author)

A81-39283 Investigation of the energy characteristics of photothermopiles S N Borisov, S M Gorodetskii, E K Iordanishvili, M B Kagan, A M Kasymakhunova, T L Liubashevskaya, and T P Dorokhina (*Geliotekhnika*, vol 16, no 3, 1980, p 7-11) *Applied Solar Energy*, vol 16, no 3, 1980, p 5-9 9 refs Translation

A composite solar cell-thermoelectric converter is described which uses the waste heat which lowers solar cell efficiency as the driver to produce electricity from thermoelectric elements. A Ga(x)Al(1-x)As-GaAs cell was chosen for its low thermal power coefficient and low series resistance, suitable for use in concentrator assemblies and a p-type BiTeSb and n-type BiTeSe semiconductor thermocouple was chosen for its high Z performance, drawing its heat in this case from four wafers of metalized silicon inserted

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under the solar cell and soldered to it. The photothermopile was tested in vacuum under photometrically controlled illuminance and liquid nitrogen was used to cool the cold junction. Once maximum power had been determined, resistance was added to the circuit to optimize performance under load. Further efforts are necessary to lower series resistance at higher temperatures and luminous intensities. D H K

A81-39284 Film photoconverters based on $Zn(x)Cd(1-x)S$ solid solutions S A Azimov, Sh A Mirsagatov, R Akhmedov, and D T Rasulov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 12-14) *Applied Solar Energy*, vol 16, no 3, 1980, p 10-13 Translation

Heterojunction solar cells with a base of a $Zn(x)Cd(1-x)S$ solid solution are studied to overcome lattice constants differences which result in discontinuities of conduction bands in low cost thin film solar cells. Cu_2S CdS cells were prepared in reactors at 900 and 1100 C with hydrogen as the transporting agent to produce grain sizes larger than the photon absorption depth. X ray analysis revealed the resulting $Zn(x)Cd(1-x)S$ films to be homogeneous and have a wurtzite structure, with 50-100 micron grains oriented in the growth direction and not to each other. A $pCu(2-x)SnZn(x)Cd(1-x)S$ heterojunction was formed by immersion in a copper bath at 80 C for 5 seconds. Control of the Zn content in solid solution was obtained and it was found that decreasing the Zn content biased the photosensitivity toward the long waves. Optimized performance was found to peak at 490 nm and load tests were used to determine an efficiency of 8.7%. The principal contribution to series resistance was due to resistance of the base and spreading resistance. Minimizing reflectance of the surface and the area covered by the current contact strips are projected to increase cell efficiency to 10%. D H K

A81-39285 Mechanisms for the degradation of the photo-current sensitivity of $Zn(x)Cd(1-x)S$ heterojunctions R V Kantariia, S Iu Pavelets, and G A Fedorus (Akademiya Nauk Ukrainskoi SSR, Institut Poluprovodnikov, Kiev, Ukrainian SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 18-21) *Applied Solar Energy*, vol 16, no 3, 1980, p 17-21 7 refs Translation

A81-39286 A device for regulating radiant flux in solar installations R A Khakimov, R A Zakhidov, and Iu M Sizov (Turkmen Academy of Sciences Central Planning Design and Production-Engineering Bureau for Scientific Instrument Construction, Uzbek SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 22-24) *Applied Solar Energy*, vol 16, no 3, 1980, p 22-24 Translation

Two luminous flux controller devices for use with solar thermodynamic power plants are presented and comprise concentrator segments which can be reoriented and a shutter for heliostat faces. The shutter is rolled and unrolled to meet in the center like a rigid theater curtain, it is controlled from either a main console or by means of a photosensitive element linked to a servomechanism for flux regulation. An aperture the size of a single heliostat facet remains in the center to maintain the tracking process, moving with an accuracy of 5 mm. An emergency fast closure drive can be activated in times of atmospheric disturbances. The composite concentrator has facets which are guided by photoelectric orientation sensors situated parallel to the optical axis of the concentrator. The facets can be diverted to an angle off the focus by command or automatically in response to a preset power level requirement, then returned to within one minute of arc by reactivation of the orientation sensors. Power steps take place in the 5-10 kW range up to the full 1 MW of the plant design. D H K

A81-39287 Investigation of optical characteristics of individual reflector for solar power plant (SPP) N B Rekant, R R Aparisi, and I I Kokhova (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 25-30) *Applied Solar Energy*, vol 16, no 3, 1980, p 25-31 6 refs Translation

Flat heliostats for a solar thermodynamic power plant are investigated for radiant energy losses in mirror absorption and reflection and to optimize the image size and energy characteristics of the reflected flux. A photoelectric circuit served as the tracking system, with a 3-7 arcmin accuracy. The 3 x 5 m reflector, made up of 28 flat 750 x 720 x 6.7 mm mirrors, directed the light onto an 81

cell 5 x 9 m receiver screen which rotated on a vertical mast. The flux was measured with sensors centered in each cell. Image overlap for maximum concentration was found to be satisfactory at 4-6 arcmin accuracy when compared to an ideal mirror. Actinometric sensors gathered data at 50, 100, 150, 217, 258, and 373 m for reflectance comparison with a standard flux of 700 kcal/sq.m.h. The images became larger than the screen at distances exceeding 250 m. Results for concentration averages and maximum concentration are provided and it is noted that the maximum angular deviation acceptable was within 30 arcmin. D H K

A81-39289 Joint heating and cooling with the aid of a solar installation using a glazed regenerator heater for the solution A Khandurdev, A Kakabaev, and Ch Kurbankuliev (Akademiya Nauk Turkmeniskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 42-47) *Applied Solar Energy*, vol 16, no 3, 1980, p 44-50 Translation

A solar unit for the joint production of heating and refrigeration has been designed on the basis of glazed solution regeneration. The unit is similar to installations employing glazed solution regenerators for cooling alone. Equations are presented for calculating specific refrigeration and heating capacities as a function of such factors as meteorological conditions. The calculations show that the unit has good heating and refrigeration capacity and that optimum performance is obtained when water must be heated to 45-55 C. S C S

A81-39290 Determination of charging and discharge for pebble-bed solar-heat store S O Khatamov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Uzbek SSR) and O Azimov (Ulugbek Samarkand State Architectural Building Institute, Samarkand, Uzbek SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 48-52) *Applied Solar Energy*, vol 16, no 3, 1980, p 51-55 Translation

A81-39291 Heat-transmission device for solar heating systems E A Nasonov and Iu I Bondarenko (Tashkent Zonal Scientific-Research Institute for Experimental Design of Residential and Public Buildings, Tashkent, Uzbek SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 56-61) *Applied Solar Energy*, vol 16, no 3, 1980, p 59-64 Translation

A reverse thermosyphon has been developed for transferring heat downward over a distance of several meters. The device has four intermediate working states: (1) condensate delivery to the evaporator, (2) fluid heating and displacement into the tank, (3) saturated vapor formation in the evaporator, and (4) fluid return from the tank to the level of the bend in the system. Numerical expressions are presented for fluid expulsion into the tank and fluid return to the evaporator. Two solar heating units utilizing the thermosyphon concept are described. Despite the apparent simplicity of the device, it is noted that it is not suited for solar receivers greater than 4-5 sq m in area. S C S

A81-39292 Investigation of optical characteristics of solar cells based on MOS structure V V Arsenin, M M Koltun, and A I Kulagin (Akademiya Nauk Uzbekskoi SSR, Institut Elektroniki, Tashkent, Uzbek SSR) (*Geliotekhnika*, vol 16, no 3, 1980, p 67-69) *Applied Solar Energy*, vol 16, no 3, 1980, p 71-73 Translation

The ways in which the photoelectric characteristics of an MOS solar cell are influenced by the parameters of the starting material have been experimentally investigated. Attention was also given to the effects of the structure's basic operating elements, such as the orientation and polishing of the silicon wafers, the thickness of the intermediate oxide and deposited barrier metal and the optical characteristics of the thin metal layers. It was concluded that the quality of Si wafer polishing is extremely important in the fabrication of MOS solar cells. Optimal values for the parameters evaluated are given, and it is noted that MOS solar cells exhibit higher relative sensitivity in the shortwave portion of the solar spectrum. S C S

A81-39293 Improving the effectiveness of solar-to-thermal energy converters based on evacuated glass tubular elements M M Koltun, O A Nevezhin, A V Romankevich, and E M Iurin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka,

Moscow, USSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 3, 4) *Applied Solar Energy*, vol 16, no 4, 1980, p 1-3 Translation

A81-39294 Study of high voltage photoelectric generators with solar radiation concentrators V V Afian, A V Vartanian, V V Zadde, T A Litsenko, D S Strebkov, and V A Unishkov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 12-15) *Applied Solar Energy*, vol 16, no 4, 1980, p 11-14 6 refs Translation

Results are presented for a study of the limiting electrical characteristics of high-voltage photoelectric generators under the action of concentrated solar radiation. The study was conducted at a solar plant with a projector-type paraboloidal concentrator with a 15 m diameter. Four photoconverter types were tested: three matrix-type high voltage structures and a planar photoconverter. The matrix-type structures included a series-connected matrix of microelements, a sawtooth-structure and bracket-shaped p-n junctions in microelements. The planar unit showed increased efficiency by a factor of 2.7 with a 40-fold increase of radiant flux power. The most promising structure is identified as the sawtooth unit, with an efficiency of 14.7% as compared to the planar unit with an efficiency of about 14%. SCS

A81-39295 On automatic control of high power solar electric station heliostat field G E Akhromenko, V M Dubilovich, O A Krasnovskaya, V A Ped'ko, A V Polunin, and N A Shapovalova (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Belorussian SSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 16-22) *Applied Solar Energy*, vol 16, no 4, 1980, p 15-21 10 refs Translation

Methods for the automated control of high power solar electric station heliostat fields are reviewed. One method assumes that the problems can be centrally solved on the basis of one or more computers. At the heliostats themselves there are only actuators and corresponding sensors. This method can also encompass well-defined hierarchical control levels which increase reliability and broaden capabilities. Another method includes autonomous heliostat automatic control systems for the normal operating regime while for abnormal regimes special control procedures are provided. This technique requires the use of microprocessors based on increasing the level of large-scale integration. The microprocessors make significant savings of cabling possible. The number of control levels and microprocessor units at each level can be determined from the cable minimization and the type of hardware being installed. SCS

A81-39297 Modeling in the design of mirror-type solar power system concentrators R A Zakhidov (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 27-32) *Applied Solar Energy*, vol 16, no 4, 1980, p 27-32 10 refs Translation

Consideration is given to modeling in the design of mirror-type solar concentrating systems. Three types of models are discussed: substantial, structural and functional. The substrate of the substantial model is identical in terms of basic properties to the substrate of the original. The structural model simulates the internal organization of the original. The functional model simulates the behavior mode of the original. Physical modeling methods establish the range of variations of the coefficients in the equations of the mathematical model. Different mathematical models are applicable to different design stages. These models, however, rely on numerical values of parameters determined through experimentation or by such optimization methods as scanning and nonlinear programming. SCS

A81-39298 Geometry of tower-type solar electric station heliostat field D I Teplakov and R R Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 32-42) *Applied Solar Energy*, vol 16, no 4, 1980, p 33-41 6 refs Translation

A general method is presented for calculating the angular positions of an arbitrary heliostat at an arbitrary position in a heliostat field surrounding a tower-type solar electric station as a function of solar position. A system of angular coordinates is used which rotates with the solar azimuth direction around the collecting tower, resulting in an expression for the proper orientation of

heliostat mirrors that is independent of local latitude, solar declination and time of day. The lines on the horizontal plane of the heliostat field characterized by the same values of the angles governing the horizontal inclination of the corresponding heliostat for a given solar elevation form two families of hyperbolas with vertices facing the center of the field. Such isoline drawings constructed from the calculations may be used to determine the limiting values of the heliostat angles during the daily and seasonal course of operation of the heliostat facility. SCS

A81-39300 Method for determining solar collector thermal characteristics under laboratory conditions Iu N Malevskii, Iu L Myshko, S I Smirnov, and B V Tarnizhevskii (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 50-54) *Applied Solar Energy*, vol 16, no 4, 1980, p 49-53 7 refs Translation

A technique is presented for the experimental determination of the thermal characteristics of a flat-plate solar collector under laboratory conditions. The technique involves the determination of the heat removal coefficient, overall loss coefficient and effectiveness coefficient of a collector from measurements of the water temperatures at the collector inlet and outlet, the water flow rate through the collector, the ambient air temperature, wind velocity and absorbing panel temperature for a solar collector connected to a tank of heated water in the absence of solar radiation. Measurements have been performed for a singly glazed collector with an absorbing panel of tube in-sheet construction at water specific flow rates from 3.9 to 48.6 kg/sq m per h, collector inlet temperatures from 24.9 to 88.6°C and room temperatures from 12.4 to 20°C. Values of the coefficient of loss through the glazing, the effectiveness coefficient, and the heat removal coefficient are in agreement with theoretical predictions. SCS

A81-39301 Photothermal solar radiation collectors M M Koltun, V P Matveev, and I P Gavrilova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, vol 16, no 5, 1980, p 3-11) *Applied Solar Energy*, vol 16, no 5, 1980, p 1-9 7 refs Translation

The optical and energy characteristics of several types of photothermal combined solar radiation collectors are compared. Both steady-state and transient regimes are considered. The models evaluated are a flat collector and two types of evacuated tube collectors. Values are also derived for the heat loss coefficient of each model. Computational and experimental results are compared. The most effective construction is found to be a combined system consisting of a thermal collector, photoelectric generator and thermal accumulator. This model also yields stable thermal characteristics under variable solar illumination conditions. SCS

A81-39303 Calculation of parabolocylindrical concentrator concentration factor N V Kolomoets, M A Markman, and Iu I Shmatok (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) (*Geliotekhnika*, vol 16, no 5, 1980, p 24-28) *Applied Solar Energy*, vol 16, no 5, 1980, p 22-26 Translation

Numerical calculations are presented for the concentration factors and optimal aperture angles of parabolocylindrical concentrators for the heat receivers of six construction variants. It is assumed that the heat receiver completely captures the reflected solar radiation. Values are likewise determined for the concentration factors and converter efficiency as a function of the size of the entrance aperture. It is found that the concentration factor can be significantly increased by increasing the relative dimension of the mirror with a relatively slight reduction of the effectiveness of using the solar energy flux striking the concentrator. SCS

A81-39304 Simplified method for calculating radiation density on the surface of tower-type solar power station receivers R R Aparisi, D I Teplakov, and B G Khantsis (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) (*Geliotekhnika*, vol 16, no 5, 1980, p 29-37) *Applied Solar Energy*, vol 16, no 5, 1980, p 27-35 7 refs Translation

A81-39305 Evaluation of concentrator characteristics R A Zakhidov and Sh I Klychev (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe Tekhnologicheskoe Biuro

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Nauchnogo Priborostroyeniya, Uzbek SSR) (*Geliotekhnika*, vol 16, no 5, 1980, p 38-42) *Applied Solar Energy*, vol 16, no 5, 1980, p 36-40 10 refs Translation

Paraboloidal one piece and faceted concentrators with diameters ranging from 1.5 to 5 m have been examined to determine cost and weight indexes as a function of concentration ratio. Numerical expressions are presented for the requirements on concentrator geometry accuracy for parabolocylinders, spheres and paraboloids of revolution. It is found that the weight indexes are basically determined by material properties, type of construction and operating conditions while cost indexes are also functions of the level and scale of production. SCS

A81-39527 Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Seminar sponsored by the Society of Photo Optical Instrumentation Engineers. Edited by S. K. Deb (Solar Energy Research Institute, Golden, CO). Bellingham, WA, Society of Photo Optical Instrumentation Engineers (SPIE Proceedings Volume 248), 1980. 183 p. \$39.

Papers are presented in the areas of silicon and nonsilicon photovoltaic solar cells, and photovoltaic concentrator solar cells based on electro optical components and the use of electro optical techniques in the characterization of photovoltaic solar cells. Specific topics include photovoltaic loss mechanisms due to defects and grain boundaries in polycrystalline silicon, minority carrier diffusion lengths and absorption coefficients in silicon sheet material, the quality factor of N(+)-P silicon solar cells, a thin-film CdS/CuInSe₂ heterojunction solar cell, the photoelectrochemical corrosion of solar cell semiconductors, luminescent solar concentrators, a gallium arsenide photovoltaic array for solar concentrators, a millimeter-wave Fabry-Pérot interferometer for conductivity measurements in thin films, and remote sensing studies of the optical properties of clouds and aerosols. ALW

A81-39529 A study of photovoltaic loss-mechanisms due to defects and grain boundaries in polycrystalline silicon. B. L. Sopori (Motorola, Inc., Solar Energy Research and Development Dept., Phoenix, AZ). In Role of electro optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 8-15. 9 refs. Contract No. DE-AC01-79ET-23104.

Various photovoltaic loss mechanisms associated with defects and grain boundaries (gbs) in polycrystalline silicon have been experimentally studied. Analysis was carried out on two types of substrates/cells viz. Wacker Silso and laser crystallized RTR ribbons. Solar cells were fabricated on selected regions of the substrates and their characteristics related to the substrate structure. Mechanisms related to photovoltaic losses are divided into two categories: electronic and physical. Parameters describing electronic loss mechanisms, such as changes in minority carrier diffusion length, dark current and local photo-current losses were measured, and their dependence on density and type of defects was determined. A variety of analytical techniques were used for this study. These include I-V characterization of solar cells, I-V characterization of gbs, and light intensity dependences of some material parameters. Loss mechanisms associated with physical effects are defect-defect and impurity-defect interactions. It is shown that physical effects such as impurity segregation and defect annihilation can lead to significant loss/gain in photovoltaic characteristics. (Author)

A81-39531 * Optoelectronic properties of cells made from various silicon forms. H. Yoo, P. Iles (Applied Solar Energy Corp., City of Industry, CA), and S. Hyland (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In Role of electro optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980.

Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 21-25. NASA-supported research.

Optoelectronic properties of the various silicon forms were obtained from the solar cell performance. Performance parameters included the photovoltaic characteristics, minority carrier diffusion length, spectral response and small light spot scanning. Self-consistent

results were obtained from the various measurement techniques, which can provide useful information on sheet quality, as a potential for low cost terrestrial applications, and areas where the sheet formation methods can be improved. (Author)

A81-39533 * Experimental and theoretical investigations of the quality factor for N(+)-P silicon solar cells. G. F. J. Garlick and A. H. Kachare (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In Role of electro optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 30-35. 17 refs. Research sponsored by the U.S. Department of Energy, Contract No. NAS7-100.

Many N(+)-P silicon solar cells made with silicon from different growth techniques have current voltage relations of the form $I = I_0(\exp(qV/kT) - 1)$, where the quality factor A is nonintegral, is greater than 1, and shows a temperature dependence. The dark forward characteristics of such cells have been measured over a range of temperatures and the behavior of the factor A derived from them. Lack of agreement with previous models has led to the development of a new model, in which N(+) conduction electrons tunnel to deep levels near that side, these levels being due to junction contamination by impurities. Electron recombination then occurs with holes thermally assisted into the junction from the P side. This mechanism involves increased I(0) values over those for diffusion diode processes and thus reduces the cell power conversion efficiency. (Author)

A81-39534 Status of nonsilicon photovoltaic solar cell research. S. K. Deb and W. L. Wallace (Solar Energy Research Institute, Golden, CO). In Role of electro optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 38-57. 105 refs.

The current status of non silicon photovoltaic solar cells is discussed, including the identification of current technical and economic issues and future research directions for potential high efficiency low cost technologies. This review covers such advanced materials as CdS/Cu₂S, CdS/CuInSe₂, and GaAs homojunction and heterojunction devices, such emerging materials as InP, Zn₃P₂ and CdTe, and liquid junction electrochemical photovoltaic cells. An attempt is made to compare the current relative status of these various technologies and to indicate their near term potential where possible. (Author)

A81-39536 Thin-film CdS/CuInSe₂ heterojunction solar cell. W. S. Chen and R. A. Mickelsen (Boeing Aerospace Co., Seattle, WA). In Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 62-69. 11 refs. Contract No. XJ-9 8021-1.

The development of a polycrystalline, thin film solar cell utilizing a heterojunction structure based upon N-type CdS and P-type CuInSe₂ semiconductor materials is described. The cell, prepared entirely by vacuum deposition and sputtering techniques onto inexpensive substrates, has potential applications as a low cost mass produced device for photovoltaic power generation systems. A device efficiency of 7.5% under simulated AM-1 illumination is reported. Material and device properties pertinent to the development of the high efficiency cell are reviewed. The electrical, optical, and structural properties of the deposited thin film materials are described. Results of detailed cell characterization using a variety of electrical, optical, and thermal measurements are presented and analyzed in terms of a photovoltaic cell model dominated by interface state recombinations. Finally, the projected, realistically achievable performance of this thin film cell is discussed. (Author)

A81-39539 Electrochemical solar cells - Principles and recent results. R. Noufi and L. Warren (Rockwell International Electronics Research Center, Thousand Oaks, CA). In Role of electro optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980.

Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 80-87. 38 refs.

The basic principles of electrochemical photovoltaic cells are reviewed, with emphasis on the semiconductor/electrolyte interface.

Systems for direct conversion of solar to electrical energy are compared with those designed for production of chemical fuels. Recent results are presented as examples. The characteristics of electrochemical solar cells are compared with those of solid state devices. (Author)

A81-39541 Progress on the development of luminescent solar concentrators. P. S. Friedman (Owens Illinois, Inc., Toledo, OH). In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 98-104. 7 refs. Research supported by the U.S. Department of Energy.

Various planar configurations of the luminescent solar concentrator (LSC) are discussed, including uniformly doped, stacked plate, thin film, and multilayered film LSC. Radiation which is lost from the luminescent plate by falling within the critical angle for total internal reflection is examined in terms of the above configurations. A ten parameter efficiency profile has been developed to better evaluate the collector performance and to allow direct comparison with other photovoltaic devices. A collector efficiency of 3.2% is reported, and the feasibility of 8-10% efficient devices discussed. Several optical distribution factors have been defined and experimentally evaluated for the luminescent plate and associated photovoltaic cell. These factors have been used to calculate a plate-to-cell optical coupling coefficient for two commercially available solar cells. LSCs based on organic and inorganic phosphor systems are compared, and the problem of dye stability is discussed. (Author)

A81-39542 Luminescent solar concentrators. J. S. Batchelder, T. Cole, (California Institute of Technology, Pasadena, CA), and A. H. Zewail. In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 105-108. 5 refs. Research supported by the U.S. Department of Energy and ARCO Solar, Inc.

A type of solar concentrator for photovoltaics utilizing light pipe trapping of luminescence is described. Total collector efficiencies of 3.2% have been measured, and efficiencies of 10% appear theoretically possible. The photodegradation lifetime of the dyes presently used is about one year under optimal conditions. (Author)

A81-39543 Solar cell characterization at Rockwell International. M. J. Cohen, J. A. Cape, M. D. Paul, D. L. Miller, and J. S. Harris, Jr. (Rockwell International Electronics Research Center, Thousand Oaks, CA). In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 109-113.

In the development of high concentration GaAs solar cells, measurements of two types are required. One type is concerned with the determination of the direct solar conversion efficiency under nominal operating conditions, while the second type is to provide data for the selection of good cells and the characterization of cell operation. The conversion efficiency is determined from an illuminated current-voltage measurement under nominal operating conditions. The major function of the selection process, which is based on several measurements, is to identify cells which will perform well before they have been bonded and packaged for high heat dissipation. This requires pulsed illumination measurements. The other diagnostic measurements determine dark current vs. voltage, spectral response vs. wavelength, and capacitance vs. voltage. A computer-controlled measurements system has been developed. G. R.

A81-39544 Gallium arsenide photovoltaic dense array for concentrator applications. J. J. Wiczer (Sandia Laboratories, Albuquerque, NM), J. A. Cape, and J. S. Harris, Jr. (Rockwell International Electronics Research Center, Thousand Oaks, CA). In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 114-118. Contract No. DE-AC04-76DP 00789.

This paper reports the design, fabrication and testing of a dense

array consisting of 16 overlapped linear modules, each containing 16 contiguous 1 cm x 1.25 cm GaAs concentrator cells in a row. The overlapping is done so that only active cell area is presented to the concentrated sunlight. The array presents a frontal area of 320 sq cm, and is designed to yield a system output of about 230 volts at 20-25 amps and 1000 suns. The results of tests carried out at concentrations up to 1500 suns and temperatures to 185 C will be presented. (Author)

A81-39546 Monolithic multicolor solar conversion. S. W. Zehr, H. T. Yang, D. L. Miller, J. S. Harris, Jr. (Rockwell International Electronics Research Center, Thousand Oaks, CA), J. J. Coleman, J. J. Yang, and R. P. Ruth (Rockwell International Electronics Research Center, Anaheim, CA). In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 125-129. 7 refs.

Jackson (1958) has suggested that significantly improved power conversion efficiency could be realized from photovoltaic converters consisting of suitably chosen, successively lower energy gap p-n junctions, coupled optically and electrically in series. Such an arrangement permits the energy distributed over the broad wavelength range of the solar spectrum to be captured and converted to electricity more efficiently than is possible with any single junction converter. First order theoretical performance calculations indicate that a well-optimized two-junction device could produce about 1.4 times the output electrical power of a similarly well optimized single junction device. A particularly attractive design approach for such 'multicolor' converters involves the assembly of the individual subcells in a monolithic stack which also includes appropriate nonrectifying and optically transparent interconnecting regions between each pair of subcells. Currently, the most highly developed multicolor converters are those made from combinations of GaAs and AlGaAs subcells joined by a tunnel junction to provide the needed intercell ohmic contact. G. R.

A81-39547 Microanalysis of solar cells. L. L. Kazmerski (Solar Energy Research Institute, Golden, CO). In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 132-137. 25 refs.

Performance and stability of solar cells may be largely determined by processes which occur on a microdimensional scale. A study of the processes which determine these qualities will, therefore, have to involve microanalytical investigations. An overview is provided of some device interface problems which have been encountered in solar cells. Examples are presented for insulator/semiconductor interfaces, and for the important intergrain or grain boundary interfaces (which dominate polycrystalline devices). Applications to Si, GaAs and InP based solar cells are cited. In order to gain chemical and compositional information on these interfaces, the surface analysis techniques of Auger electron spectroscopy (XPS) are applied in a complementary fashion as diagnostic tools. Correlation of these measurements is made both with solar cell performance (i.e. open-circuit voltage, short circuit current, efficiency), and directly with specific area electrical activity using in situ electron beam induced current techniques. G. R.

A81-39548 Optical considerations in solar cell design. P. Iles and S. Khemthong (Applied Solar Energy Corp., City of Industry, CA). In: Role of electro-optics in photovoltaic energy conversion, Proceedings of the Seminar, San Diego, CA, July 31, August 1, 1980. Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p. 138-141.

A81-39657 // Conversion of solar radiation into laser radiation in the Xe + Cs mixture (O preobrazovanii solnechnogo izlucheniya v lazernoe na smesi Xe+Cs). L. I. Gudzenko, A. L. Golger, and S. I. Yakovenko. In: Kinetic models in laser physics and the theory of oscillations. Moscow, Izdatel'stvo Nauka, 1980, p. 84-90. 12 refs. In Russian.

The possibility of obtaining laser action in an Xe + Cs mixture under solar radiation pumping is examined. The Cs(7 2 P_{1/2}) Cs(5 2 D_{3/2}) transition at a wavelength of 13,800 Å is taken as the working

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transition. It is shown that laser action is possible if the collisional deexcitation cross section of Cs(6P) is sufficiently large. In this case, it is possible to achieve conversion of solar energy into laser radiation with an efficiency of about 0.6%. It is found that laser radiation power can attain a value of about one kilowatt in the case of 25-times solar energy concentration in an active medium 0.45 x 15 m in size. P T H

A81-39658 # Solar-radiation pumped gas laser (Gazovyy laser s solnechnym vzbuzhdeniem) L I Gudzenko, B F Gordiets, and V Ia Panchenko. In: Kinetic models in laser physics and the theory of oscillations. Moscow, Izdatel'stvo Nauka, 1980, p 90-99. 22 refs. In Russian.

A theoretical study is presented of the operation of a solar-radiation-pumped CW Br₂-CO₂ He laser, with laser action at the 10.6-micron wavelength of CO₂. Gain, laser output power, and efficiency of direct conversion of solar energy into laser radiation energy were calculated. It is shown that, under certain solar energy concentration conditions, it is possible to achieve a gain of 0.00008 per cm, an output power of about 1 W/m, and an efficiency of about 1%. P T H

A81-39770 Interference-enhanced long-wavelength response in amorphous silicon solar cells. W den Boer and M Ondris (Delft, Technische Hogeschool, Delft, Netherlands). *Solar Cells*, vol 3, May 1981, p 209-213. 8 refs.

Amorphous silicon (a-Si) solar cells with several back contact metals were investigated. It is shown that cells with highly reflecting back contacts have an increased collection efficiency in the wavelength region 600-700 nm. This is due to multiple reflection in the thin a-Si film. By varying the film thickness the position of the interference peak in the spectral response can be optimized. In this way the efficiency of a gold Schottky barrier solar cell without antireflection coating was increased from 1.6% to 1.8%. The optimum film thickness was found through computer calculations. (Author)

A81-39772 An economic analysis of photoelectrochemical cells. N L Weaver, R Singh, K Rajeshwar, P Singh, and J Dubow (Colorado State University, Fort Collins, CO). *Solar Cells*, vol 3, May 1981, p 221-232. 14 refs. Contract No. XP9-80029.

The economic viability of photoelectrochemical cells is examined for two representative systems based on n-type GaAs and n-type CdSe electrodes in contact with aqueous polyselenide and polysulfide electrolytes respectively. Cell fabrication costs for these systems are compared with a test case comprising a sequence of processes in a typical fabrication of silicon p-n junction solar cells. A standardized methodology based on the solar array manufacturing industry costing standards improved price estimation guideline is employed for the comparison. Under the framework of assumptions implicit in this analysis, photoelectrochemical systems emerge as a viable cost-competitive option to silicon p-n junction solar cells. The sensitivity of the computed cell costs to parameters such as cell efficiency and material costs is discussed. (Author)

A81-39773 Silicon solar cells with integral bypass diodes. M A Green, E Gauja, and W Withayachamnankul (New South Wales, University, Kensington, Australia). *Solar Cells*, vol 3, May 1981, p 233-244. 12 refs. Research supported by the Australian Department of National Development and Energy.

Field experience has brought to light undesirable features of the operation of solar cell arrays due fundamentally to mismatch in the output of individual cells. These difficulties can be avoided if bypass diodes are connected across cells or groups of cells. A new technique is described for integrating bypass diodes into the solar cell structure with minimal additional cell processing. After fabrication the cell can be interconnected in the same manner as conventional cells. Experimental results are described verifying proposed processing sequences and system performance of the cells. (Author)

A81-39775 Reliability considerations in the design of solar photovoltaic power systems. L H Stember (Battelle Columbus Laboratories, Columbus, OH). *Solar Cells*, vol 3, May 1981, p 269-285. 5 refs.

A systems level approach to reliability analyses for solar photovoltaic systems is presented, and it is shown how these analyses

can be useful in photovoltaic systems design even though detailed reliability data are not yet available. Traditional reliability techniques and trade offs are discussed, and relationships between reliability, maintainability, and availability are reviewed employing minimum life cycle cost as the parameter to be optimized. A list of available techniques that are useful today is presented, as is a list providing a series of techniques that will be useful when more field and test reliability data on photovoltaic systems are available. Three typical solar photovoltaic systems are shown in block diagrams and discussed. They are (1) a stand alone photovoltaic system, (2) a stand alone system with battery energy storage, and (3) a system with a utility back up. Each system is analyzed to the subsystem level with the aid of two reliability analysis techniques: the failure modes and effects analyses and the fault tree approach. C R

A81-39850 Experimental test on a gravity controlled solar concentrator. C Pontiggia and G A Rottigni (Genova, Università, Genova, Italy). *Nuovo Cimento C, Serie 1*, vol 46, Mar-Apr 1981, p 145-163. 5 refs.

The design of a solar concentrator of variable density distribution with geometry determined by the force of gravity is examined, and results of experimental testing of the concentrator are presented. The concentrator is based on a reflecting lamina with one end fixed and the other end displaced as solar elevation changes to allow the focusing of solar radiation at a point. In order to maximize the solar concentration efficiency, the shape of the lamina is transformed from a catenary curve to a parabola by the suspension of chains of variable length from numerous positions along the sides of the lamina, reproducing a variable lamina density distribution. Measurements of the dispersion of laser radiation reflected from positions along the lamina as a function of radiation incidence have shown the concentrator to be capable of maintaining concentration at a fixed point as the mobile point of the lamina is tracked along a calculated trajectory. A L W

A81-39856 Graded-index Pt-Al₂O₃ composite solar absorbers. H G Craighead, R E Howard, J E Sweeney (Bell Telephone Laboratories, Inc., Holmdel, NJ), and R A Buhrman (Cornell University, Ithaca, NY). *Applied Physics Letters*, vol 39, July 1, 1981, p 29-31. 9 refs. Contract No. EG 77-S 03 1456.

The solar absorption properties of thin composite films of coevaporated Pt and Al₂O₃, formed with a graded composition-depth profile, are compared to those of an identical film overcoated with a microscopically textured layer of SiO₂/x/. The composition grade of the metal-dielectric composite and the surface texturing of the SiO₂/x/ produces a film with a refractive index slowly varying to unity at the front surface. This results in a very low reflectance of the film. The solar absorptivity of this graded refractive index surface is shown to be as high as 0.98. The production and structure of these surfaces are described as well as a general method of absorptivity enhancement using a microscopically textured surface formed by reactive ion etching. (Author)

A81-39860 The effect of atomic hydrogen passivation on polycrystalline silicon epitaxial solar cells. P H Robinson and R V D'Aiello (RCA Laboratories, Princeton, NJ). *Applied Physics Letters*, vol 39, July 1, 1981, p 63, 64. 6 refs. Contract No. XS9 8274.

Solar cells fabricated in 20 micron thick epitaxial layers grown on p(+) polycrystalline upgraded metallurgical grade silicon substrates were subjected to atomic hydrogen passivation at 400 C for 3-1/2 h. The measured solar-cell characteristics show marked increases in open circuit voltage, fill factor, and efficiency after hydrogenation. (Author)

A81-39861 Induced back-surface field solar cells on p-type silicon substrates. N G Tarr, D L Pulfrey (British Columbia, University, Vancouver, Canada), and P A Iles (Applied Solar Energy Corp., City of Industry, CA). *Applied Physics Letters*, vol 39, July 1, 1981, p 83-85. 10 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada.

Recent research has shown that negative barrier metal insulator semiconductor (MIS) contacts can exhibit the same minority carrier reflecting properties as diffused back-surface field regions. This letter describes the use of negative-barrier platinum-MIS contacts to form the first induced back-surface field solar cells on p-type silicon substrates. P+ SiO₂/x/pSi back contacts have been applied both to cells with diffused front junctions and to cells with minority carrier

injecting MIS front junctions. In both cases an enhancement in open circuit voltage comparable to that obtained with diffused back surface fields has been observed. The negative barrier MIS contact has also been found to increase the infrared photocurrent.

(Author)

A81-39863 Zinc phosphide-zinc oxide heterojunction solar cells. P. S. Nayar and A. Catalano (Delaware, University, Newark, DE). *Applied Physics Letters*, vol. 39, July 1, 1981, p. 105-107. 9 refs. Contract No. XR9 8062.

Zinc phosphide-zinc oxide heterojunction solar cells have been prepared by sputter-depositing ZnO onto a Zn₃P₂ substrate. An active area conversion efficiency of 2% has been obtained. In the absence of shunts and by reducing the series resistance of the device, an efficiency of 5% is achievable. The experimental results are discussed in terms of an interface recombination model. It is indicated that the interface plays a significant role in determining the cell characteristics of the p-Zn₃P₂/n-ZnO heterojunction. V. L.

A81-40025 Modification of the Hottel-Whillier-Bliss equation for cover absorption effects in solar collectors. N. E. Wijesundera (University of Singapore, Singapore). *Regional Journal of Energy, Heat and Mass Transfer*, vol. 3, Jan. 1981, p. 1-10. 5 refs.

The effects of solar radiation absorption and the thermal resistance of a solar collector cover system on the various factors which occur in the Hottel-Whillier-Bliss (HWB) equation are considered. It is shown that by extending the thermal network analogy to systems with distributed heat sources, the heat transfer analysis of the collector can be done with little computational effort. The analysis also leads to a simple form of the HWB equation, with additional factors to account for the source distribution and the thermal resistance of the cover system, and it is applicable to conventional flat plate collectors and to other thermal trap collectors. A series of calculations for multilayer systems is presented to show the relative importance of the various factors in the modified HWB equation for different cover configurations. K. S.

A81-40299 Flash technique for GaAs concentrator solar cell measurement. E. Fanetti (Centro Informazioni, Studi ed Esperienze S.p.A., Milan, Italy). *Electronics Letters*, vol. 17, June 25, 1981, p. 469, 470. 5 refs. Research supported by the Ente Nazionale per l'Energia Elettrica.

The paper describes a flash-lamp testing technique for the measurement of GaAs concentrator solar cells. The advantage of this technique compared with other pulsed techniques is that the whole I-V curve can be recorded with only one shot, permitting the evaluation of efficiency, fill factor, and series resistance of the cell at high concentration (greater than 1000 suns). A comparison with outdoor measurements is presented. B. J.

A81-40355 Effect of annealing on resistivity and photoconductivity of solar-grade polycrystalline silicon and on solar-cell performance. G. C. Jain, B. C. Chakravarty, and A. Prasad (National Physical Laboratory of India, New Delhi, India). *Journal of Applied Physics*, vol. 52, May 1981, p. 3700, 3701. 8 refs.

The ratio α of the resistivity of the annealed and unannealed samples for different grain sizes and temperatures of annealing is shown in a graph. It is found that this ratio increases with the increase in the temperature of annealing and decreases as the grain size is increased. Another graph shows the ratio β of the photoconductivity of the annealed and unannealed samples as a function of grain size for different temperatures of annealing. It is seen that β varies more or less like α . In both cases measurements were conducted at 900 C, 1000 C, and 1100 C. A third graph shows the effect on the performance of solar cells of annealing the starting material at 1100 C in air. It is seen that heat cycling did not have any noticeable effect on the open-circuit voltage but severely affected the short circuit current, which depends on the lifetime of the holes in the n region to as much as 70 or 80%. G. R.

N81-22144 Midwest Research Inst., Golden, Colo. Solar Energy Research Inst. **PHOTOELECTROSYNTHESIS AT SEMICONDUCTOR ELECTRODES**
A. J. Nozik. Dec. 1980. 33 p. refs. Presented at 3rd Intern.

Conf. on Photochem. Conversion and Storage of Solar Energy, Golden, Colo. (Contract DE-AC02-77CH-00178) (SERI/TP-623-1045, CONF-800827-4) Avail. NTIS HC A03/MF A01.

The general principles of photoelectrochemistry and photoelectrosynthesis are reviewed and some new developments in photoelectrosynthesis are discussed. Energetics of semiconductor-electrolyte interfaces (band-edge unpinning), hot carrier injection at illuminated semiconductor-electrolyte junctions, derivatized semiconductor electrodes, particulate photoelectrochemical systems, layered compounds and other new materials, and dye sensitization are discussed. DOE.

N81-22401 Teldix Luftfahrt-Ausruestungs G.m.b.H. Heidelberg (West Germany).

A BAPTA EMPLOYING ROTARY TRANSFORMERS, STEPPER MOTORS AND CERAMIC BALL BEARINGS
W. Auer. In: NASA Marshall Space Flight Center. The 15th Aerospace Mech. Symp. May 1981, p. 189-203. refs.

Avail. NTIS HC A19/MF A01. CSCL 09A.

The utilization of rotary transformers as an alternative to slip rings for the power transfer from solar panels to a satellite's main body could be advantageous, especially if an ac bus system is taken into consideration. Different approaches with main emphasis on the electromagnetic design were investigated and showed efficiencies of up to 99% with a 3 kW power capability. A solidly preloaded pair of ball bearings with ceramic balls assures proper transformer air gaps and acceptable torque changes over temperature and temperature gradients. The bearing and power transfer assembly is driven by a direct drive stepper motor with inherent redundancy properties and needs no caging mechanism. Author.

N81-22465 General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.

PHOTOVOLTAIC CONCENTRATOR ARRAY PRODUCTION STUDY, VOLUME 1 STUDY SUMMARY Final Report, 25 Jan. 1979 - 24 Jan. 1980
R. C. Hodge. Jan. 1981. 30 p. refs.
(Contract DE-AC04-76DP-00789)
(SAND-79-7055/1) Avail. NTIS HC A02/MF A01.

The latest and projected concentrator photovoltaic designs were defined and analyzed in terms of their performance and energy cost potentials. The major hardware areas of interest were the basic concentrator modules to include concentrator optics and solar cell receiver assemblies. Both reflective and refractive optics were investigated as well as linear and point-focus cell receivers. Performance was assessed at the individual concentrator module and array levels. Power conditioning and field distribution factors were not addressed. Detailed optimizations were performed to identify production-oriented hardware designs. Resultant energy costs were then estimated at the factory and installed array levels. Results and conclusions are presented. DOE.

N81-22469 Rockwell International Corp., Downey, Calif. Space Operations and Satellite Systems Div.
SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY (EXHIBIT D) VOLUME 5 SYSTEMS ENGINEERING/INTEGRATION RESEARCH AND TECHNOLOGY Final Report
G. M. Hanley. Washington: NASA, Mar. 1981. 216 p. refs. 7 Vol.

(Contract NAS8-32475)
(NASA-CR-3396, SSD-80-0108-5) Avail. NTIS HC A10/MF A01. CSCL 10A.

Guidelines and ground rules followed in the development of requirements for the SPS are presented. Development planning objectives are specified in each of these areas, and evolutionary SPS program scenarios are described for the various concepts studied during the past one year contract. Program descriptions are presented as planning packages of technical tasks, and schedule phasing. Each package identifies the ground based technology effort that will facilitate SPS definitions, designs, development and operations. T.M.

N81-22471 Wilson-Hill Associates, Inc., Washington, D.C. **SOLAR SPACE AND WATER HEATING SYSTEM INSTALLED**

02 SOLAR ENERGY

AT CHARLOTTESVILLE, VIRGINIA Final Report

Sep 1980 100 p
(Contract EG-77-A-01-4095)
(NASA-CR-161675) Avail NTIS HC A05/MF A01 CSCL 10A

The solar energy system located at David C. Wilson Neuropsychiatric Hospital, Charlottesville, Virginia, is described. The solar energy system consists of 88 single glazed, Sunworks 'Solactor' copper base plate collector modules, hot water coils in the hot air ducts, a Domestic Hot Water (DHW) preheat tank, a 3,000 gallon concrete urethane insulated storage tank and other miscellaneous components. Extracts from the site files, specifications, drawings, installation operation and maintenance instructions are included. SF

N81-22480# Coast Guard Research and Development Center Groton, Conn

EVALUATION OF SOLAR PHOTOVOLTAIC ENERGY STORAGE FOR AIDS TO NAVIGATION Interim Report

W R Allen, J S Ryba, and S E Trenchard Nov 1980 71 p refs
(AD-A096476, CGR/DC-12/80, USCG-D-5-81) Avail NTIS HC A04/MF A01 CSCL 10/3

A detailed discussion of the U.S. Coast Guard aids to navigation application of solar photovoltaics with an emphasis on energy storage by lead-acid batteries is presented. A methodology is developed for the prediction of performance of a lead-acid battery in low-rate photovoltaic charging. Experimental results from five years of solar photovoltaic charging of lead-antimony grid batteries at various levels of voltage regulation are discussed. A two-level, two-factorial experiment with pure-lead grid batteries is analyzed. An experimental comparison is made between pure-lead grid and lead-calcium grid batteries. The results of temperature-controlled zener diode voltage regulator testing are presented. All three grid types of lead-acid batteries were found to be acceptable for aids to navigation usage with different constraints on voltage regulation and maintenance needed for each type. A final discussion is presented on the considerations for the operational deployment of solar photovoltaic-powered aids to navigation. GRA

N81-22483# Rockwell International Corp., Anaheim, Calif Electronics Research Center
DEVELOPMENT OF HIGH-EFFICIENCY STACKED MULTIPLE-BANDGAP SOLAR CELLS Interim Technical Report, 1 Aug 1978 - 1 Oct 1979

R P Ruth, J S Harris, F D Dapkus, R D Dupuis, and S W Zehr Wright-Patterson AFB, Ohio AFWAL Oct 1980 177 p refs
(AD-A096764, C78-1225 28/501, AFWAL-TR-80-2096) Avail NTIS HC A09/MF A01 CSCL 10/2

The first 14 month program of a twenty-four month experimental investigation backed by analytical modeling has been conducted to develop technologies required for fabricating stacked multiple bandgap solar cell (SMBSC) assemblies having AMO 1-sun efficiencies of 25% or greater at 25 C. Investigations were undertaken with the following four SMBSC materials systems: (1) two-cell GaAs-Ge structure, made by metalorganic chemical vapor deposition (MO-CVD), conventional CVD, and molecular-beam epitaxy (MBE) methods; (2) two-cell GaAs-InGaAs structure, made by liquid-phase epitaxy (LPE) techniques; (3) three-cell GaAlAs-GaAs-GaAsSb structure, made by MO-CVD and MBE methods; and (4) three-cell GaAlAs-GaAs-InGaAsP structure, made by LPE and MBE methods. Each of these systems involves the GaAlAs-GaAs materials combination as the basic building block. Near the end of the program a change in emphasis was introduced to limit the investigations to GaAlAs-GaAs and GaAs-Ge two-cell structures and the three-cell GaAlAs-GaAs-Ge structure that might also result. Principal emphasis was then placed on the MO-CVD technique supplemented by MBE, LPE, or other deposition and/or processing techniques where appropriate. The principal achievement was with the GaAlAs-GaAs system in which a two-cell SMBSC that exhibited voltage addition (V_{oc} approx = 2.1 V) under illumination was successfully fabricated. The two individual cells and the connecting tunnel junction were grown entirely by MO-CVD techniques in this structure. Similar structures made by a combination of MO-CVD and MBE techniques also appeared quite promising. GRA

N81-22484# Schumacher (J. C.) Co., Oceanside, Calif
LOW-COST SILICON PROCESS DEVELOPMENT PHASE 4:

PROCESS IMPROVEMENT Quarterly Technical Progress Report

E Moore and C Newman Jan 1981 18 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-9279-1-T1, QTPR-1) Avail NTIS HC A02/MF A01

Three project tasks include process improvement studies, kinetic studies, and process economic studies. Process improvement studies in a miniplant focused on the correlation of current miniplant yield results with prior laboratory scale work. The silicon product reactor was operated in the thermal disproportionation mode and successfully processed 35 kilograms of tribromosilane. The yield during the test ranged from 75 to 85% of theoretical. The experimental apparatus for use in the determination of the decomposition rate of tribromosilane was assembled, tested and placed into service. The computer code, REPORT, for plant daily operations data keeping is given. DOE

N81-22486# Martin Marietta Aerospace, Denver, Colo
SOLCOST-PASSIVE SOLAR ENERGY DESIGN PROGRAM USERS GUIDE

Sep 1980 69 p
(Contract DE-AC02-76ET-20102)
(DOE/ET-20102/T1) Avail NTIS HC A04/MF A01

The SOLCOST-PASSIVE solar energy design program is a public domain interactive computer design tool intended for use by non-thermal specialists to size passive solar systems with a methodology based on the Los Alamos Solar Load Ratio (SLR) method. A life cycle savings analysis is included. An overview of SOLCOST-PASSIVE capabilities and the Solar Load Ratio method which it is based on is presented. A detailed guide to the SOLCOST-PASSIVE input parameters is given. Sample problems showing typical execution sessions and the resulting SOLCOST-PASSIVE output are included. Appendices A thru D provide details on the SLR method and the life cycle savings methodology of SOLCOST-PASSIVE. DOE

N81-22491# Public Service Co. of New Mexico, Albuquerque
COMMERCIAL SOLAR/LOAD MANAGEMENT EXPERIMENT: NEW MECHANICAL ENGINEERING BUILDING Interim Report, period ending Jul 1980

J M Noble Jan 1981 35 p refs Sponsored by Electric Power Research Inst
(EPRI Proj 844-2)
(EPRI-EM-1680) Avail NTIS HC A03/MF A01

The effects of load management, heat recovery, thermal storage, and solar systems on energy usage and power demand profiles in the University of New Mexico's Mechanical Engineering Building are presented. Results were obtained from a year monitoring of the buildings heating and cooling systems and recording of sensor signals by a computer based data acquisition system. A modified AXCESS Energy Analysis Program to simulate energy usage is detailed, and the development of preferred strategies for maximizing the building's load management capabilities is outlined. DOE

N81-22493# Decision Planning Corp., Costa Mesa, Calif
PASSIVE AND HYBRID SOLAR ENERGY PROGRAM

Nov 1980 310 p
(Contracts DE-AT02-77CH-99002, EW-78-C-02-4970)
(DOE/CS-4970/1) Avail NTIS HC A14/MF A01

The background and scope of the program is presented in general terms. The program plan is summarized describing how individual projects are categorized into mission oriented tasks according to market sector categories. The individual projects funded by DOE are presented as follows: residential buildings, commercial buildings, solar products, solar cities and towns, and agricultural buildings. A summary list of projects by institution (contractors) and indexed by market application area is included. DOE

N81-22603# Los Alamos Scientific Lab., N. Mex. Solar Energy Group

SOLAR ENERGY RESEARCH AT LASL Progress Report, 1 Oct 1979 - 31 Mar 1980

Sherry K. Reisfeld, comp. and Donald A. Neeper, comp. 31 Mar 1980 58 p refs
(LA-8450-PR) Avail NTIS HC A04/MF A01

The work of Q-11, the Solar Energy Group of the Los Alamos

Scientific Laboratory, is documented for October 1979 through March 1980 Q-11 conducted passive solar heating research and collector testing. In addition, the group provided technical support to the Department of Energy, Office of Solar Applications for Buildings, for both solar collector and passive system development. Author

N81-22529# Duke Univ Durham, N C Dept of Mechanical Engineering and Materials Science
PREPARATION AND CHARACTERIZATION OF HYDROGENATED AMORPHOUS BORON THIN FILMS AND THIN FILM SOLAR CELLS PRODUCED BY GLOW DISCHARGE DECOMPOSITION METHODS Final Report, 1 Jan 1979 - 31 May 1980

Franklin H Cocks, Phillip L Jones, Louis J Dimmey, Stuart F Cogan and Hymog Park May 1980 21 p refs
 (Contract DE-AC03-79ET-23041)
 (DOE/ET-23041/4) Avail NTIS HC A02/MF A01

The presence of hydrogen in the films in the range of 5 to 34% has been confirmed by residual gas analysis. The optical band gaps of these films can be varied from as much as 2.2 eV to 0.9 eV by vacuum annealing. In particular, films with optical gaps close to the optimum (1.45 eV) for solar cell applications can be readily produced either by post deposition annealing or the use of substrates heated to 3500 C. Heating of the substrates during deposition of the films produced varying optical gaps. Evolution of incorporated hydrogen by these means is believed to lead to the lowering of the optical gap. Boron films produced from plasmas into which small amounts of silane and hydrogen were introduced showed lower activation energies for conduction than did the intrinsic a-B H films. DOE

N81-22530# Duke Univ Durham, N C Dept of Mechanical Engineering and Materials Science

PREPARATION AND CHARACTERIZATION OF HYDROGENATED AMORPHOUS SILICON THIN FILMS AND THIN FILM SOLAR CELLS PRODUCED BY ION PLATING TECHNIQUES Final Report, 1 Jan. 1979 - 31 May 1980

Franklin H Cocks, Phillip L Jones, Stuart F Cogan, Louis J Dimmey, Barry L Zalph, Alan S Scharman, Anti Korhonen, and Steven Wright May 1980 45 p refs
 (Contract DE-AC03-79ET-23035)

(DOE/ET-23035/4) Avail NTIS HC A03/MF A01

The technique involves essentially the evaporation of elemental silicon through a d.c. produced hydrogen plasma. In this way hydrogen successfully incorporated into amorphous silicon films in concentrations as high as 30 atomic percent. Infrared spectroscopy indicates the usual SiH sub x stretching mode at approximately 2000/cm. Further evidence for the bonding of hydrogen was obtained from ESR measurement of hydrogenated and unhydrogenated samples. The measured unpaired spin density was a factor of 25 less in the hydrogenated sample. The optical absorption edges of the hydrogenated films fell in the usual range between 1.7 and 1.9 eV. Electrical conductivity measurements indicated a substantial reduction in the density of defect states in the gap as expected. DOE

N81-22531# InterTechnology Solar Corp, Warrenton Va Solar Marketing and Manufacturing Div

REVIEW OF THE CURRENT STATUS OF REVERSE ELECTRODIALYSIS SYSTEMS FOR SALINITY POWER SYSTEMS USING A STRATIFIED SATURATED SOLAR POND Final Report

22 Feb 1980 47 p refs
 (Contract DE-AC05-78ET-20471)

(DOE/ET-20471/T1 Rept-220280) Avail NTIS HC A03/MF A01

It is shown that the electrical resistance of the present day membranes, which are produced for electrodialysis and not reverse electrodialysis, and the solution compartments are very high. This causes the power density of present day RED stacks, in terms of watts per unit membrane area, to be very low. This factor combined with the high cost of present day membranes results in very high costs for the RED stack. Furthermore, present day membranes as well as adhesives for membrane assemblies cannot operate at about 800 °C for any reasonable length of time without severe deterioration in performance. DOE

N81-22533# Research Triangle Inst Research Triangle Park, N C

DEVELOPMENT OF HIGH EFFICIENCY, LOW COST ZnSs2 SOLAR CELLS Quarterly Technical Progress Report, 1 Jan - 31 Mar 1980

J E Andrews 1980 15 p

(Contract DE-AC04-79ET-23001)

(COO-3001-4 QTPR-4) Avail NTIS HC A02/MF A01

The p-ZnSiAs2/n-GaAs structures fabricated earlier, were analyzed using the Electron Beam Induced Current technique and were found to have a diffused p-n junction in the GaAs. The short circuit current density associated with this structure was found to be a factor of 2 to 3 lower than predicted when analyzed as a ZnSiAsw/GaAs heteroface structure (the ZnSiAs2 was assumed to behave as a window layer). Epitaxial growth was demonstrated for two additional substrates. DOE

N81-22534# Brookhaven National Lab, Upton N Y Dept of Energy and Environment

ADVANCED AMORPHOUS MATERIALS FOR PHOTOVOLTAIC CONVERSION Semiannual Report, 1 Oct 1979 - 31 Mar 1980

R W Griffith, A E Delaney, M D Hirsh, F J Kampas, and P E Vanier 1980 38 p refs

(Contract DE-AC02-76CH-00016)

(BNL-51260) Avail NTIS HC A03/MF A01

The following activities were emphasized in the program: an expansion of plasma studies using optical emission spectroscopy in order to identify emitting reactive species due to impurities; and electrical and optical measurements on alloys with calibrated impurity levels by measurements of photoconductivity, photoluminescence, vibrational spectroscopy, etc. The apparatus for device measurements of spectral response, dark I-V characteristics, illuminated I-V characteristics, etc., was completed. DOE

N81-22537# Argonne National Lab III
DESIGN REQUIREMENTS FOR ORBIT MAINTENANCE OF SPS ELEMENTS

Nov 1980 70 p refs

(Contract W-31-109-eng-38)

(DOE/ER-0087) Avail NTIS HC A04/MF A01

The LEO Staging Base, Electric Orbit Transfer Vehicle, the LEO Construction Base, and SPS Self-Power Module are the SPS elements selected for this analysis. The orbit decay rates and attitude control/orbit maintenance propellant requirements for nominal and worst case conditions are defined. The sequence of events that could cause unplanned reentry are defined. The design and operational requirements that will be used to prevent the various elements from deorbiting are defined. DOE

N81-22538# Chicago Univ, III
NONIMAGING CONCENTRATORS FOR SOLAR THERMAL ENERGY Final Report

R Winston and Joseph J Gallagher 21 Mar 1980 99 p refs

(Contracts DE-AS02-76ET-20236, EY-76-S-02-2446)

(DOE/ET-20236/18) Avail NTIS HC A05/MF A01

A small experimental solar collector test facility was used to explore applications of nonimaging optics for solar thermal concentration in three substantially different configurations: a single stage system with moderate concentration on an evacuated absorber (a 5.25X evacuated tube Compound Parabolic Concentrator or CPC); a two stage system with high concentration and a non-evacuated absorber (a 16X Fresnel lens/CPC type mirror); and moderate concentration single stage systems with non-evacuated absorbers for lower temperature (a 3X and a 6.5X CPC). Prototypes of each of these systems were designed, built and tested. The performance characteristics are presented. DOE

N81-22544# Los Alamos Scientific Lab, N Mex
SOLAR ENERGY RESEARCH AT LASL Progress Report, 1 Oct 1979 - 31 Mar 1980

Sherry K Reisfeld, comp and Donald A Neeper, comp Nov 1980 56 p refs

(Contract W-7405-eng-36)

(LA-8450-PR) Avail NTIS HC A04/MF A01

The Solar Energy Group, Q-11, conducted passive solar heating research and collector testing. In addition, the group provided technical support to the Department of Energy, Office of Solar Applications for Buildings, for both solar collector and passive system development. DOE

02 SOLAR ENERGY

N81-22545# Rockwell International Corp., Anaheim, Calif
Electronic Devices Div

THIN FILMS OF InP FOR PHOTOVOLTAIC ENERGY CONVERSION Quarterly Technical Progress Report, 29 Dec 1979 - 28 Mar 1980

Harold M. Manasevit, Ralph P. Ruth, Lavada A. Moudy, Jane J. Yang, and Richard E. Johnson. Apr 1980. 39 p. refs
(Contract DE-AC02-79ET-23004)

(COO-3004-3 QTPR-3) Avail NTIS HC A03/MFA01

The development of a low cost high efficiency thin film InP heterojunction solar cell based on InP films grown by the metalorganic chemical vapor deposition (MO CVD) is discussed. Experiments continued on evaluation of GaP as an intermediate layer material for subsequent growth of InP films on various substrate materials, and Cd (obtained from dimethylcadmium) was evaluated as a p-type dopant (an alternative to Zn obtained from diethylzinc) for InP films made by the MO-CVD process. A preliminary X-ray diffraction analysis was conducted of the crystallographic structure of the vacuum-deposited CdS films prepared as part of the process of fabricating CdS/InP heterojunction solar cells. A group of CdS/InP heterostructure cells involving vacuum-deposited CdS and p-type epitaxial InP films grown by MO-CVD was prepared and evaluated. High J₀ values and low fill factors were observed in all of the cells, resulting in AM1.5 efficiencies in the 2 to 5 percent range. DOE

N81-22547#, Automation Industries, Inc. Silver Spring, Md
Vitro Labs Div

SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION SCATTERGOOD SCHOOL, WEST BRANCH, IOWA, JUNE 1979 - APRIL 1980

Eric M. Schatzberg. 1980. 84 p. refs

(SOLAR/2003-80/14) Avail NTIS HC A05/MF A01

The Scattergood School solar energy system supplied 93% of the space heating and 50% of the domestic hot water required for the school. The system operated from June 1979 to April 1980 with no mechanical failures. The grain drying subsystem was used during the last two weeks of October. Operation of the grain drying subsystem considerably improved overall system performance. DOE

N81-22549# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

GROWTH OF SILICON SHEETS FOR PHOTOVOLTAIC APPLICATIONS

Thomas Surek. Dec 1980. 18 p. refs

(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/TR-614-921) Avail NTIS HC A02/MF A01

Silicon sheet growth processes are classified according to their linear growth rates. The fast growth processes, which include edge-defined film-fed growth, silicon on ceramic, dendritic-web growth, and ribbon-to-ribbon growth, were comparatively ranked subject to criteria involving growth stability, sheet productivity, impurity effects, crystallinity, and solar cell results. The status of more rapid silicon ribbon growth techniques such as horizontal ribbon growth and melt quenching was also reviewed. The emphasis of the discussions is on examining the viability of these sheet materials as solar cell substrates for low-cost silicon photovoltaic systems. DOE

N81-22551# Mobil Tyco Solar Energy Corp., Waltham, Mass.
AMORPHOUS-SILICON THIN-FILM HETEROJUNCTION SOLAR CELLS Progress Report, 1 Mar. - 1 Dec 1980

Mary C. Cretella, James Gregory, Donald B. Sandstrom, and William Paul (Harvard Univ.). Jan 1981. 29 p.
(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/PR-9056-1-T1) Avail NTIS HC A03/MF A01

Amorphous silicon materials were investigated (1) to improve the amorphous material, and (2) to attempt to understand and improve on the limitations of the junction devices while evaluating the amorphous silicon materials. The modifications to the a-Si(H) network by alloying silicon with other group IVA elements, either in binary or ternary compositions, and/or by replacing the hydrogenation for defect compensation with a combination of hydrogenation and alkylation or hydrogenation and halogenation are examined. The doped junction layers are examined in an attempt to determine the limiting characteristics of the junctions in solar cell devices of these amorphous materials. The optical properties were measured, and structural and compositional information was obtained from the IR vibrational spectra using

the scanning electron microscope and from analyses using scanning Auger microscopy. Electrical measurements include the dark conductivity and the photoconductivity under room fluorescent light and at AM1 conditions. With alloys that displayed promising photoconductive properties n-i-p devices are prepared to assess the solar cell properties. DOE

N81-22552# Sandia Labs. Livermore, Calif

SIMPLE THEORY FOR PREDICTING THE NATURAL CONVECTIVE ENERGY LOSS FROM SIDE-FACING SOLAR CAVITY RECEIVERS

M. Abrams and R. Greif. Jan 1981. 45 p. refs

(Contract DE-AC04-76DP-00789)

(SAND-81-8201) Avail NTIS HC A03/MF A01

The approach used is to determine the velocity distribution of the incoming air in the aperture plane (and thereby the rate of mass entrainment) and then to estimate the bulk temperature of the heated emerging air. The convective loss is then calculated from an energy balance. To illustrate this theory, numerical results applicable to the 2.15 meter cubic cavity being tested in the laboratory are provided. DOE

N81-22553# Northrup, Inc., Hutchins, Tex.

SECOND GENERATION HELIOSTAT DEVELOPMENT DETAILED DESIGN REPORT, VOLUME 1 TECHNICAL DISCUSSION Technical Report, 16 Jul. 1979 - 30 Apr. 1980

1980. 265 p. refs

(Contract DE-AC04-76DP-00789)

(SAND-79-8194-Vol-1) Avail NTIS HCA12/MFA01

Presented are the design of the second generation heliostat, the development of the manufacturing plan, the method of transporting the heliostats from the factory to the installation site, heliostat installation procedures, and the maintenance routines. These plans were then cost estimated to provide inputs required to develop the installed cost of the heliostat and further, the cost of owning, operating and maintaining a collector field. DOE

N81-22554# Argonne National Lab. Ill.

PRELIMINARY OPTICAL DESIGN OF A SECOND-STAGE CONCENTRATOR FOR THE CRTF Final Report

K. A. Reed. Feb 1981. 66 p. refs

(Contract DE-AC04-76DP-00789)

(SAND-79-7108) Avail NTIS HC A04/MF A01

The definition and design of a water cooled, second stage compound parabolic concentrator to be employed in the MDAC/R receiver panel testing are described. A simplified flux model (SFM) was developed to permit fast computation of the total power normally incident on an arbitrary planar target aperture from some or all of the heliostats in the field. For each second stage concentrator configuration studied, the total power normally incident on each entrance aperture was calculated using the SFM, and then the net power delivered to the MDAC/R receiver panel was calculated from the optical transmission of the concentrator. The SFM code is included. DOE

N81-22554# Sandia Labs., Albuquerque, N. Mex.

SOLAR HEATING MATERIALS HANDBOOK. ENVIRONMENTAL AND SAFETY CONSIDERATIONS FOR SELECTION

Jan 1981. 275 p. refs

(Contract DE-AC04-76DP-00789)

(DOE/TIC-11374) Avail NTIS HC A12/MF A01

Properties are discussed for six classes of materials for solar heating systems: heat transfer fluids, glazing materials, insulation, seals and sealants, thermal storage media, and absorber materials. The properties important to the functioning of the material class are defined and discussed, and values for these properties are given for specific materials. Types of properties discussed include functional properties, compatibility properties, environmental response properties, hazardous properties, and environmental impact properties. A glossary and index are included. DOE

N81-22557# Southern Methodist Univ., Dallas, Tex.

THIN FILM GALLIUM ARSENIDE SOLAR CELL RESEARCH Quarterly Report, 1 Sep. - 30 Nov 1980

Shirley S. Chu. Dec 1980. 31 p. refs. Sponsored in part by Midwest Research Inst.

(Contract EG-77-C-01-4042)

(SERI/PR-9002-3-T1, QR-3) Avail NTIS HC A03/MF A01

Major efforts during this quarter were directed to the optimization of the deposition of gallium arsenide films of 10 micro m thickness or less on tungsten/graphic substrates, the investigation of the effectiveness of various grain boundary passivation techniques, the deposition of tantalum pentoxide by ion beam sputtering as an antireflection coating, the deposition of gallium aluminum arsenide by the organometallic process, and the fabrication and characterization of large area Schottky barrier type solar cells from gallium arsenide films of about 10 micro m thickness. Various grain boundary passivation techniques, such as the anodic oxidation, thermal oxidation and ruthenium treatment are investigated. DOE

**N81-22571# Sandia Labs, Albuquerque, N Mex
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY
PREDICTIONS FOR THERMAL PERFORMANCE BASED ON
TEST DATA SUN-HEET NONTRACKING SOLAR COLLEC-
TOR**

Thomas D Harrison Mar 1981 23 p ref

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/4) Avail NTIS HC A02/MF A01

The thermal performance predictions for the Sun-Heet nontracking, line-focusing parabolic trough collector at five cities in the US are presented. DOE

**N81-22572# Sandia Labs, Albuquerque, N Mex
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY
PREDICTIONS FOR THERMAL PERFORMANCE BASED ON
TEST DATA: AAI SOLAR COLLECTOR WITH PRESSURE-
FORMED GLASS REFLECTOR SURFACE**

Thomas D Harrison Mar 1981 22 p ref

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/5) Avail NTIS HC A02/MF A01

The thermal performance predictions for the AAI solar line focusing stat type collector for five cities in the US are presented. DOE

**N81-22573# Sandia Labs, Albuquerque, N Mex
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY
PREDICTIONS FOR THERMAL PERFORMANCE BASED ON
TEST DATA, ACUREX SOLAR COLLECTOR WITH GLASS
REFLECTOR SURFACE**

Thomas D Harrison Mar 1981 25 p ref

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/6) Avail NTIS HC A02/MF A01

The thermal performance predictions for the Acurex solar line-focusing parabolic trough collector for five cities in the US are presented. DOE

**N81-22574# Sandia Labs, Albuquerque, N Mex
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY
PREDICTIONS FOR THERMAL PERFORMANCE BASED ON
TEST DATA SOLAR KINETICS T-700 SOLAR COLLECTOR
WITH GLASS REFLECTOR SURFACE**

Thomas D Harrison Mar 1981 25 p ref

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/7) Avail NTIS HC A02/MF A01

The thermal performance predictions for the Solar Kinetics solar line-focusing parabolic trough collector for five cities in the US are presented. DOE

**N81-22575# Sandia Labs, Albuquerque, N Mex
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY
PREDICTIONS FOR THERMAL PERFORMANCE BASED ON
TEST DATA ALPHA SOLARCO 104 SOLAR COLLECTOR
WITH 0.125-INCH SCHOTT LOW-IRON GLASS REFLECTOR
SURFACE**

Thomas D Harrison Apr 1981 24 p ref

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/8) Avail NTIS HC A02/MF A01

Thermal performance predictions based on test data are presented for the Alpha Solarco Model 104 solar collector, with a 0.125-inch Schott low-iron glass reflector surface, for three output temperatures at five cities in the United States. DOE

**N81-23214# EIC, Inc, Newton, Mass
DEVELOPMENT OF PHOTOELECTROCHEMICAL CELLS
BASED ON COMPOUND SEMICONDUCTORS AND
NONAQUEOUS ELECTROLYTES Quarterly Technical
Progress Report, 1 Aug - 31 Oct 1980**

R D Rauh Dec 1980 27 p refs Sponsored in part by Midwest Research Inst

(Contract DE-AC02-77CH-00178)

(SERI/PR-8002-7-T1) Avail NTIS HC A03/MF A01

A solar cell using polyvinylpyrrolidone treated polycrystalline n-GaAs and CH₃CN 13(-)/1(-) electrolyte achieved a power conversion efficiency of 4.3% with i (sub sc) = 11.6 mA/sq cm, V (sub oc) = -0.485V, P (sub max) = 2.3 mW/sq cm ff = 0.40 at 53.3 mW/sq cm X_e arc intensity. A p-GaAs electrode in the same acetonitrile electrolyte gives photovoltages similar to those reported for aqueous HI/12 electrolyte, but the photocurrent decays rapidly with time. Exploratory work on pZn3P2 indicates that nonaqueous electrolytes will probably be required for EPCs based on this semiconductor due to a dark reaction of Zn3P2 with H2O to liberate PH3. Stable photoresponse was obtained in CH3CN 13(-)/1(-). DOE

**N81-23220# California Univ, Berkeley Lawrence Berkeley
Lab Lab of Chemical Biodynamics**

**HOLLOW-FIBER MEMBRANES FOR PHOTSENSITIZED
ELECTRON TRANSPORT**

Carl C Wamser, John W Otvos, and Melvin Calvin Jan 1981 31 p

(Contract W-7405-eng-48)

(LBL-12359) Avail NTIS HC A03/MF A01

Commercially available cellulose acetate hollow fiber membranes were investigated for possible use in artificial photosynthesis solar energy schemes. The function of the membrane is to contain the photosensitizer and to separate the oxidized and reduced species which result from photosensitized electron transfer reactions on each side of the membrane wall. Membranes were successfully modified by a process of soaking in a THF solution saturated with porphyrin, followed by a water rinse. This procedure gives dark purple fibers which contain up to 30 mM zinc tetraphenylporphyrin in the fiber walls. A plumbing system was developed to allow flow of a solution through the inner channels of a 24-fiber bundle while it is immersed in a separate outer solution. Preliminary photochemical studies on cut-up pieces of the treated fiber indicated that it does photosensitize a reaction between EDTA and dimethyl viologen in aqueous solution. DOE

**N81-23222# California Univ, Berkeley Lab of Chemical
Biodynamics**

**MAGNETIC-FIELD EFFECTS ON PHOTSENSITIZED
ELECTRON TRANSFER REACTIONS**

Carl C Wamser, John W Otvos, and Melvin Calvin Jan 1981 15 p refs

(Contract W-7405-eng-48)

(LBL-12361) Avail NTIS HC A02/MF A01

Reactions which proceed through the intermediacy of a triplet radical pair can be affected by the application of an external magnetic field of relatively low intensity (100 to 1000 gauss). Since many of the photoreactions utilized in solar energy schemes are electron transfer reactions involving triplet radical pairs, experiments were performed with representative photoreactions to determine if such effects could enhance reaction efficiency. No magnetic field effects were observed in any of the experiments which included the photosensitized reduction of dimethyl viologen sensitized by Ru(bipy)₃ 3 (+2) or by various porphyrins in homogeneous aqueous solution or in reversed micelles (water in toluene) or on silica particles. Apparently the magnetic field effects reported in the literature are observable only under specific conditions. Under the conditions normally utilized for typical solar energy photoreactions, magnetic field effects do not appear to be useful for optimizing efficiency. DOE

**N81-23501# Midwest Research Inst Golden Colo Components
Development Group**

**ASSESSMENT OF EXISTING STUDIES OF WIND LOADING
ON SOLAR COLLECTORS**

L M Murphy Feb 1981 35 p refs

(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/TR-632-812) Avail NTIS HC A03/MF A01

Current design and testing procedures for wind loading are discussed. The test results corresponding to numerous wind tests on heliostats, parabolic troughs, parabolic dishes, and field-mounted photovoltaic arrays are discussed and the applicability of the findings across the various technologies is assessed. One of the most significant consistencies in the data from all the technologies is the apparent benefit provided by fences and field

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shielding These data show that load reductions of three or possibly more seem feasible, though a more thorough understanding of the phenomena involved must be attained before this benefit can be realized DOE

N81-23502# Midwest Research Inst, Golden, Colo WIND LOADING ON TRACKING AND FIELD-MOUNTED SOLAR COLLECTORS

L M Murphy Dec 1980 10 p refs
(Contracts DE-AC02-77CH-00178 EG-77-C-01-4042)
(SERI/TP-632-958) Avail NTIS HC A02/MF A01

Current design and testing procedures for wind loading are discussed The test results corresponding to numerous wind tests on heliostats parabolic troughs, parabolic dishes, and field-mounted photovoltaic arrays are discussed and the applicability of the findings across the various technologies is assessed One of the most significant consistencies in the data from all of the technologies is the apparent benefit provided by fences and field shielding These data show that load reductions of three, or possibly more, seem feasible though a more thorough understanding of the phenomena involved must be attained before this benefit can be realized DOE

N81-23597*# RKL Controls Co, Lumberton, NJ SOLAR HEATING AND COOLING SYSTEM INSTALLED AT RKL CONTROLS COMPANY, LUMBERTON, NEW JERSEY Final Report

Mar 1981 258 p Sponsored in cooperation with NASA
(Contract EX-76-C-01-2397)
(NASA-CR-161679) Avail NTIS HC A12/MF A01 CSDL
10A

The final results of the design and operation of a computer controlled solar heated and cooled 40,000 square foot manufacturing building sales office, and computer control center/display room are summarized The system description test data major problems and resolutions performance operation and maintenance manual equipment manufacturers' literature and as-built drawings are presented The solar system is composed of 6 000 square feet of flat plate collectors external above ground storage subsystem controls absorption chiller heat recovery, and a cooling tower J D H

N81-23599*# Rockwell International Corp, Canoga Park, Calif SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY, EXHIBIT F Final Report

G M Hanley 28 Apr 1981 157 p
(Contract NAS8-32475)
(NASA-CR-161750, SSD-81-0059) Avail NTIS
HC A08/MF A01 CSDL 10B

Preliminary technical data were derived for three new system satellite concepts The concepts are a geo-solar array and antenna with free-flying geo-solar reflector, a geo-solar array and antenna with free-flying geo-radio-frequency reflector, and a sun-synchronous solar array and antenna with free-flying geo-radio-frequency reflector Parametric data are provided on microwave sidelobe reduction as a function of design changes T M

N81-23601*# Jet Propulsion Lab, California Inst of Tech, Pasadena PHOTOVOLTAICS PROGRAM UTILITY INTERFACE SOUTH- WEST REGIONAL WORKSHOP PROCEEDINGS

I S Bengelsdorf 1 Apr 1981 53 p Proceedings of Workshop
held in Pasadena, Calif, 9-10 Sep 1980
(Contracts NAS7-100, DE-AI01-76ET-20356 JPL Proj
5220-10)

(NASA-CR-164284, JPL-Pub-81-32, DOE/ET-20356/2) Avail
NTIS HC A04/MF A01 CSDL 10A

The needs and constraints of the utilities are summarized The capabilities and limitations of photovoltaic systems as an alternative electricity generation option by utilities are discussed T M

N81-23604*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala

DEVELOPMENT AND TESTING OF THERMAL ENERGY STORAGE MODULES FOR USE IN ACTIVE SOLAR HEATING AND COOLING SYSTEMS Final Report

John C Parker Apr 1981 34 p Prepared in cooperation
with Artech Corp, Falls Church, Va Prepared for DOE
Washington D C

(Contract NAS8-32254)

(NASA-TM-82415) Avail NTIS HC A03/MF A01 CSDL
10A

The project development requirements and criteria are presented along with technical data for the modules Performance tests included ducting, temperature, pressure and air flow measurements, dry and wet bulb temperature, duct pressure measurements and air conditioning apparatus checks installation, operation and maintenance instructions are included T M

N81-23606*# Ferebee, Walters and Associates, Charlotte N C SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT CHARLOTTE MEMORIAL HOSPITAL, CHARLOTTE, NORTH CAROLINA Final Report

May 1981 67 p refs Sponsored by NASA
(Contract EX-76-C-01-2394)
(NASA-CR-161731) Avail NTIS HC A04/MF A01 CSDL
10A

Detailed information regarding the design and installation of a heating and hot water system in a commercial application is given This information includes descriptions of system and building, design philosophy control logic operation modes, design and installation drawing and a brief description of problems encountered and their solutions Author

N81-23614*# Sanders Associates, Inc Nashua, N H HIGH TEMPERATURE SOLAR RECEIVER Final Report, 7 Jun 1979 - 7 Apr 1981

7 Apr 1981 37 p
(Contract JPL-955454)
(NASA-CR-164332, JPL-9950-529) Avail NTIS
HC A03/MF A01 CSDL 10A

The development of a high temperature solar thermal receiver is described A prototype receiver and associated test support (auxiliary) hardware was fabricated Shakedown and initial performance tests of the prototype receiver were performed Maximum outlet temperatures of 1600 F were achieved at 100% solar (70-75 kW) input power with 900 F inlet temperatures and a subsequent testing was concluded by a 2550 F outlet run The window retaining assembly was modified to improve its tolerance for thermal distortion of the flanges It is shown that cost effective receiver designs can be implemented within the framework of present materials technology E A K

N81-23615*# Motorola, Inc, Phoenix, Ariz Semiconductor Group

THE ESTABLISHMENT OF A PRODUCTION-READY MANUFACTURING PROCESS UTILIZING THIN SILICON SUBSTRATES FOR SOLAR CELLS Final Report

R A Pryor Oct 1980 217 p Sponsored in part by DOE
Prepared for JPL
(Contract JPL-955328, JPL Proj 2364, et al)
(NASA-CR-164327 DOE/JPL-955328-80/4, JPL-9950-528
DRL-99, DRD-SE-5, Motorola-2364/4) Avail NTIS
HC A10/MF A01 CSDL 10A

Three inch diameter Czochralski silicon substrates sliced directly to 5 mil, 8 mil, and 27 mil thicknesses with wire saw techniques were procured Processing sequences incorporating either diffusion or ion implantation technologies were employed to produce n+p or n+pp+ solar cell structures These cells were evaluated for performance ease of fabrication, and cost effectiveness It was determined that the use of 7 mil or even 4 mil wafers would provide near term cost reductions for solar cell manufacturers Author

N81-23616*# Solarex Corp, Rockville Md A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOP- MENT UNIT (MEPSDU) Quarterly Report, 26 Nov 1980 - 28 Feb 1981

1981 117 p refs Sponsored in part by DOE Prepared for
JPL
(Contract JPL-955902)

(NASA-CR-164325, DOE/JPL-955902-81/1, JPL-9950-527,
DRL-156, DRD-SE-3) Avail NTIS HC A06/MF A01 CSDL
10A

The technical readiness of a cost effective process sequence that has the potential for the production of flat plate photovoltaic modules which met the price goal in 1986 of \$70 or less per Watt peak was demonstrated The proposed process sequence was reviewed and laboratory verification experiments were conducted The preliminary process includes the following features

semicrystalline silicon (10 cm by 10 cm) as the silicon input material, spray on dopant diffusion source Al paste BSF formation spray on AR coating electroless Ni plate solder dip metallization, laser scribe edges, K & S tabbing and stringing machine and laminated EVA modules JMS

N81-23617*# Science Applications, Inc., McLean Va
COST EFFECTIVE FLAT PLATE PHOTOVOLTAIC MODULES USING LIGHT TRAPPING Final Report

C N Bain, B A Gordon, T M Knsel and R L Malinowski
 Apr 1981 242 p refs Sponsored by NASA Prepared for JPL

(Contract JPL-955787)

(NASA-CR-164320 DOE/JPL-955677-81/1, JPL-9950-538, SAI-82-451-WA) Avail NTIS HC A11/MF A01 CSCL 10A

Work in optical trapping in thick films is described to form a design guide for photovoltaic engineers. A thick optical film can trap light by diffusive reflection and total internal reflection. Light can be propagated reasonably long distances compared with layer thicknesses by this technique. This makes it possible to conduct light from inter-cell and intra-cell areas now not used in photovoltaic modules onto active cell areas. TM

N81-23620*# Westinghouse Electric Corp Pittsburgh, Pa
 Advanced Energy Systems Div
DESIGN, FABRICATION, AND BENCH TESTING OF A SOLAR CHEMICAL RECEIVER Final Report

William A Summers and Joseph F Pierre Jan 1981 97 p refs

(Contracts NAS7-100, JPL-955639)

(NASA-CR-164333 JPL-9950-537, AESD-TME-3103) Avail NTIS HC A05/MF A01 CSCL 10A

Solar thermal energy can be effectively collected, transported, stored, and utilized by means of a chemical storage and transport system employing the reversible SO₂ oxidation reaction. A solar chemical receiver for SO₃ thermal decomposition to SO₂ and oxygen was analyzed. Bench tests of a ten foot section of a receiver module were conducted with dissociated sulfuric acid (SO₃ and H₂O) in an electrical furnace. Measured percent conversion of SO₃ was 85% of the equilibrium value. Methods were developed to fabricate and assemble a complete receiver module. These methods included applying an alumina coating to certain exposed surfaces, assembling concentric tubes with a wire spacer, applying a platinum catalyst to the tubing wall, and coiling the entire assembly into the desired configuration. TM

N81-23622*# Pennsylvania Univ Philadelphia Moore School of Electrical Engineering

ANALYSIS AND EVALUATION IN THE PRODUCTION PROCESS AND EQUIPMENT AREA OF THE LOW-COST SOLAR ARRAY PROJECT Quarterly Report, Jul - Oct 1980

M Wolf and H Goldman Jan 1981 174 p Sponsored in part by DOE Prepared for JPL

(Contract JPL-954796)

(DOE/JPL-954796-81/12 JPL-9950-534) Avail NTIS HC A08/MF A01 CSCL 10A

The attributes of the various metallization processes were investigated. It is shown that several metallization process sequences will lead to adequate metallization for large area, high performance solar cells at a metallization add-on price in the range of \$6 to 12/m squared or 4 to \$8/W(peak) assuming 15% efficiency. Conduction layer formation by thick film silver or by tin or tin/lead solder leads to metallization add-on prices significantly above the \$6 to 12/m squared range. c) The wet chemical processes of electroless and electrolytic plating for strike/barrier layer and conduction layer formation respectively, seem to be most cost effective. RCT

N81-23623*# Acurex Corp Mountain View Calif Alternate Energy Div

ADVANCED SOLAR CONCENTRATOR PRELIMINARY AND DETAILED DESIGN Final Report

D M Bell, R A Maraschin, M T Matsushita, D Erskine, R Carlton, A Jakovcevic, and A K Yasuda Mar 1981 252 p (Contracts NAS7-100, JPL-955477 Acurex Proj 7740)

(NASA-CR-164316, ACUREX-FR-80-16/AE) Avail NTIS HC A12/MF A01 CSCL 10A

A single reflection point focusing two-axis tracking paraboloidal dish with a reflector aperture diameter of approximately 11 m has a reflective surface made up of 64 independent optical

quality gores. Each gore is a composite of a thin backsilvered mirror glass face sheet continuously bonded to a contoured substrate of lightweight rigid cellular glass. The use of largely self-supporting gores allows a significant reduction in the weight of the steel support structure as compared to alternate design concepts. Primary emphasis in the preliminary design package for the low-cost, low-weight mass producible concentrator was placed on the design of the higher cost subsystems. The outer gore element was sufficiently designed to allow fabrication of prototype gores. ARH

N81-23624*# Acurex Corp Mountain View, Calif Alternate Energy Div

ADVANCED SOLAR CONCENTRATOR EXECUTIVE SUMMARY Final Report

Mar 1981 42 p refs

(Contract JPL-955477)

(NASA-CR-164318 ACUREX-FR-81-10/AE) Avail NTIS HC A03/MF A01 CSCL 10A

The preliminary design of a point-focusing solar concentrator consisting of a steerable space frame structure supporting a paraboloidal mirror glass reflector, is described. A mass production operation and maintenance cost assessment is presented. A conceptual evaluation of a modified concentrator design is included. The detailed design of one of the lightweight, structurally efficient reflective elements comprising the paraboloidal reflective surface is given. JDH

N81-23628# Air Force Academy Colo Dept of Civil Engineering

THE UNITED STATES AIR FORCE ACADEMY SOLAR ENERGY RESEARCH PROJECT SOLAR TEST HOUSE Final Interim Report, May 1978 - Jan 1980

Anthony Eden, Joel D Benson, Kenneth A Cornelius, and Gregory E Riggs Jul 1980 170 p refs

(AF Proj 2054)

(AD-A097212, AFESC/ESL-TR-80-34) Avail NTIS HC A08/MF A01 CSCL 13/1

This research continued to gather operational performance data and maintenance experience on a retrofit residential solar space heating system. Data analysis includes comparison to prior years' results. Separate chapters are devoted to analyzing the performance of evacuated tube collectors and the home's reaction to sole dependency on solar energy during a selected winter period. Considerable attention is given to actions that were taken to prepare the system for a return to normal occupancy (the home was vacant until October 1979). Information concerning the perceived need for development of an operations and maintenance manual and a homeowners' manual is included. Complete copies of the developed manuals are appendices to this report. Author (GRA)

N81-23630# Londe-Parker-Michels Inc, St Louis Mo
WINTER EXPERIENCE OF A PASSIVE SOLAR RETROFIT Final Technical Report

T I Michels and F S Andes 23 Dec 1980 8 p Presented at the Colloq Solaire Intern Nice, France, 11 Dec 1980

(Contract DE-FG04-77CS-34127)

(DOE/CS-34127/1, CONF-801218-3) Avail NTIS HC A02/MF A01

An older home in St Louis had 2 inch foam insulation added to the outside of masonry walls with stucco exterior finish applied. The south wall was modified so that there is a gross solar collection area of 262 square m, with 132 square m of greenhouse, 86 square m of direct gain and 44 square m of Trombe components. The performance of the building and its data acquisition system are described. DOE

N81-23632# Rockwell International Corp Anaheim Calif Electronic Devices Div

THIN FILMS OF InP FOR PHOTOVOLTAIC ENERGY CONVERSION Final Report, 5 Jul 1979 - 4 Jul 1980

Harold M Manasevit, Ralph P Ruth, Lavada A Moudy, Jane J J Yang, and Richard E Johnson Aug 1980 164 p refs

(Contract DE-AC02-79ET-23004)

(COO-3004-4, C80-331/501) Avail NTIS HC A08/MF A01

Research to develop a low cost high efficiency thin film InP heterojunction solar cell, using the metalorganic chemical vapor deposition (MOCVD) technique for InP film growth on suitable substrates is reported. The research effort involved three major technical tasks: materials growth, materials characterization, and

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device fabrication and characterization Temperature-activated orientation-dependent background donor doping was observed in undoped epitaxial InP films P type epitaxial films of InP were prepared by Zn and by Cd doping during growth The efficacy of Cd doping was found to vary exponentially with the reciprocal of the deposition temperature in the range 650 to 730 C TM

N81-23633# Electric Power Research Inst Palo Alto Calif
ELECTRIC UTILITY SOLAR ENERGY ACTIVITIES 1980 SURVEY Special Report, Dec 1980
Mary C Wentworth Dec 1980 283 p
(EPRI-AP-1713-SR) Avail NTIS HC A13/MF A01

Brief descriptions of 839 projects being conducted by 236 utility companies are given Also included are an index of projects by category a statistical summary, a list of participating utilities with information contacts and addresses a list of utilities with projects designated by category, a list of utilities organized by state a list of available reports on utility sponsored projects and a list of projects having multiple utility participants Project categories include solar heating and cooling of buildings, wind energy conversion, solar thermal electric power photovoltaics biomass conversion process heat and ocean energy conversion DOE

N81-23637# Dwyer-Mercer County District Public Library Celina, Ohio

SOLAR PASSIVE CEILING SYSTEM Final Report

Austin R Schneider 1980 75 p

(Contract DE-FG02-79R5-10148)

(DOE/R5-10148/2) Avail NTIS HC A04/MF A01

The construction of a 1200 square foot building with full basement built to be used as a branch library in a rural area is described The primary heating source is a passive solar system consisting of a south facing window system The system consists of a set of windows located in the south facing wall only, composed on double glazed units a set of reflectors mounted in each window which reflects sunlight up to the ceiling (the reflectors are similar to venetian blinds) a storage area in the ceiling which absorbs the heat from the reflected sunlight and stores it in foil salt pouches laid in the ceiling, and an automated curtain which automatically covers and uncovers the south facing window system The system is totally passive and uses no blowers pumps or other active types of heat distribution equipment The building contains a basement which is normally not heated and the north facing wall is bermed four feet high around the north side DOE

N81-23646# Varian Associates, Palo Alto, Calif

MATERIALS FOR HIGH EFFICIENCY MONOLITHIC MULTIGAP CONCENTRATOR SOLAR CELLS Semiannual Report, 1 Jul - 31 Dec 1980

1980 25 p refs

(Contract DE-AC02-77CH-00178)

(SERI/TR-8081-1-T3) Avail NTIS HC A02/MF A01

Material technologies were directed towards the development of a two-gap monolithic lattice-matched concentrator cell with 28 percent or higher AM2 conversion efficiency at 500 to 1000 suns The work performed is subdivided into the five major tasks develop and demonstrate the technology for a grading layer of GaInAs/GaAs and low bandgap cells in AlGaInAs/GaInAs/GaAs develop and demonstrate intercell tunnel junction contacts in the higher bandgap AlGaInAs alloys develop and demonstrate technology for a higher bandgap concentrator cell in AlGaInAs alloys demonstrate a complete two gap monolithic concentrator cell with AM2 efficiency of 28 percent or more and investigate the potential of AlInAsSb alloys grown on InAs substrates TM

N81-23647# Automation Industries, Inc Silver Spring Md Vitro Labs Div

PERFORMANCE OF ACTIVE SOLAR SPACE-COOLING SYSTEMS THE 1980 COOLING SEASON

D Blum S Frock T Logee D Missal and P Wetzel 1980 155 p refs

(Contract DE-AC01-79CS-30027)

(SOLAR/0023-81/40) Avail NTIS HC A08/MF A01

Solar cooling by an absorption chiller is not a cost effective method to use solar heat This statement is substantiated by careful analysis of each subsystem and equipment component Good designs and operating procedures are identified The

problems which reduce cost effectiveness are pointed out There are specific suggestions for improvements Finally there is a comparison of solar cooling by absorption chilling and using photovoltaic cells DOE

N81-23648# Applied Physics Lab Johns Hopkins Univ Laurel Md

VACUUM-DEPOSITED POLYCRYSTALLINE SILICON FILMS FOR SOLAR-CELL APPLICATIONS Final Technical Report, 14 Sep 1979 - 1 Dec 1980

Charles Feldman Charles H Arrington III Norman A Blum and Frank G Satkiewicz Dec 1980 184 p refs

(Contracts DE-AC02-77CH-00178 ET-78-A-03-2208)

(SERI/TR-8278-1-T4) Avail NTIS HC A09/MF A01

A process was explored in which the solar cell was constructed in layers as follows alumina (or sapphire) substrate/TiB2 bottom electrode/p-type polycrystalline silicon film/n-type polycrystalline silicon film/Ti-Ag top electrode Techniques were developed for forming stable, low resistivity thin films of TiB2 The p-layer was vacuum deposited by electron beam heating of Si and B sources The n-layer was formed both by thermal diffusion and by silicon deposition in a phosphine atmosphere Both methods yielded photodiodes the diffused junctions were studied more extensively and consequently produced the higher efficiency devices DOE

N81-23650# Lincoln Lab Mass Inst of Tech Lexington

DETECTION OF ELECTRICALLY FAILED PHOTOVOLTAIC MODULES AT MIT LL TEST SITES

S E Forman Feb 1981 27 p refs

(Contract DE-AC02-76ET-20279)

(DOE/ET-20279/112) Avail NTIS HC A03/MF A01

These sites contain modules from several manufacturers and serve as test beds for photovoltaic system components Between May 1977 and the present, over 11 000 modules were placed into service at these sites with a total of approximately 250 electrical failures Emphasis has been placed on failure modes and the types of physical and electrical degradation found in modules The methods used to detect these failures in operational photovoltaic power-generating systems are reported DOE

N81-23652# Battelle Inst Frankfurt am Main (West Germany) Solid State Physics Sect

DEVELOPMENT OF SINGLE-CRYSTALS CdTe SOLAR CELLS FOR TERRESTRIAL APPLICATION IN OPTICAL CONCENTRATORS - Final Report

Hans Jaeger Bernd Fuessl Emil Seipp and Rita Thiel Dec 1980 84 p refs

(BMFT-FB-T-80-060) Avail NTIS (US Sales Only)

HC A05/MF A01 DOE Depository Libraries

Semitransparent Au-Schottky barrier contacts and p-type ZnTe layers were evaporated on n-type CdTe wafers to form photovoltaic structures CdS and indium tin oxide (ITO) layers both of n-type were deposited on p CdTe wafers Schottky diodes on n CdTe exhibit a high photocurrent ZnTe was found to be of high resistivity however it was possible to deposit low resistivity transparent ZnTe layers First solar cell samples of n CdS and ITO on p CdTe yielded 3% cell efficiency The ohmic contacts on p type CdTe are the critical element in this case The solar cells of p CdTe/n CdS (or ITO) seem to be the better approach Concentrator applications will presumably not be possible because the contact resistances are not low enough DOE

N81-23657# Veda, Inc Camarillo, Calif

ECONOMIC ANALYSIS OF THE UNIFIED HELIOSTAT ARRAY Final Report

31 Jan 1981 430 p

(Contract DE-AC03-80SF-10802)

(DOE/SF-10802/1) Avail NTIS HC A19/MF A01

Two heliostats, the Veda Industrial Heliostat (VIH) and the Repowering Heliostat were investigated in conjunction with the UHA The UHA was found to be a viable candidate for solar thermal central receiver applications The UHA-VIH combination was shown to provide very high flux densities and to be suitable for high temperature applications in the 10000 K to 20000 K range These temperatures were shown to be achievable even with very small (1 MWt) collector fields DOE

N81-23660# Rockwell International Corp, Thousand Oaks Calif Electronics Research Center

DEVELOPMENT OF POLYCRYSTAL GaAs SOLAR CELLS
Technical Progress Report, 15 Jan - 30 Sep 1980

D L Miller Marshall J Cohen and J S Harris Jr Oct 1980
 13 p Prepared for Midwest Research Inst., Golden Colo
 (Contract DE-AC02-77CH-00178)
 (SERI/PR-8032-1-T1) Avail NTIS HC A02/MF A01

Schottky diodes were made on epitaxial GaAs layers grown by molecular beam epitaxy on polycrystal substrates with grain size from 1 to 10 mm, the measured dark forward current-voltage characteristics are plotted. The modeling method and calculated plots of current-voltage characteristics with grain size as a parameter, open circuit voltage and short circuit current vs grain size and efficiency and fill factor vs grain size for Schottky barrier polycrystal solar cells are given and discussed DOE

N81-23671# Exxon Research and Engineering Co Linden N.J.
Advanced Energy Systems Labs
SOLAR THERMAL ENHANCED OIL RECOVERY (STEOR)
VOLUME 1 EXECUTIVE SUMMARY Final Report, 1 Oct 1979 - 30 Jun 1980

Eugene Elzinga, Charles Arnold David Allen Robert Garman Patrick Joy Paul Mitchell and Henry Shaw Nov 1980 38 p refs Prepared in cooperation with Foster Wheeler Development Corp and Honeywell Inc Minneapolis 3 Vol (Contract DE-AC03-79CS-30307) (SAN-0307-1-Vol-1) Avail NTIS HC A03/MF A01

Thermal enhanced oil recovery is widely used in California to aid in the production of heavy oils. Steam injection either to stimulate individual wells or to drive oil to the producing wells, is by far the major thermal process today and has been in use for over 20 years. Since steam generation at the necessary pressures (generally below 4000 kPa (580 psia)) is within the capabilities of present day solar technology it is logical to consider the possibilities of solar thermal enhanced oil recovery (STEOR). The present project consisted of an evaluation of STEOR Program objectives, system selection, trade-off studies, preliminary design, cost estimate, development plan, and market and economic analysis are summarized DOE

N81-23672# Exxon Research and Engineering Co Linden, N.J.
Advanced Energy Systems Lab
SOLAR THERMAL ENHANCED OIL RECOVERY (STEOR),
VOLUME 2, SECTIONS 2-8 Final Report, 1 Oct 1979 - 30 Jun 1980

Eugene Elzinga Charles Arnold David Allen Robert Garman, Patrick Joy Paul Mitchell and Henry Shaw Nov 1980 357 p refs Prepared in cooperation with Foster Wheeler Development Corp Livingston, NJ and Honeywell Inc Minneapolis 3 Vol (Contract DE-AC03-79CS-30307) (SAN-0307-1-Vol-2) Avail NTIS HC A16/MF A01

The technical, economic, operational, and environmental feasibility of solar thermal enhanced oil recovery using line focusing distributed collectors are determined. The quantity of solar heat which might be applied to domestic enhanced oil recovery is estimated. Selection of the solar system trade-off studies, preliminary design for steam raising, cost estimate, the development plan and a market and economics analysis are presented DOE

N81-23673# Exxon Research and Engineering Co Linden N.J.
Advanced Energy Systems Lab
SOLAR THERMAL ENHANCED OIL RECOVERY (STEOR)
VOLUME 2 APPENDICES Final Report, 1 Oct 1979 - 30 Jun 1980

Eugene Elzinga Charles Arnold David Allen Robert Garman, Patrick Joy, Paul Mitchell and Henry Shaw Nov 1980 333 p refs Prepared in cooperation with Foster Wheeler Development Corp Livingston NJ and Honeywell Inc, Minneapolis 3 Vol (Contract DE-AC03-79CS-30307) (SAN-0307-1-Vol-2-App) Avail NTIS HC A15/MF A01

Detailed information describing the technical, economic, operational, and environmental feasibility of solar thermal enhanced oil recovery using line focusing distributed collectors is presented. The site description, conceptual designs, foundation design for solar collectors, design basis and preliminary design are given. The fatigue testing of flexible hoses is described. Solar control and a failure modes and effects analysis of solar thermal system are presented. The basis for the preliminary cost estimate and backup data for the market and economic analysis are presented. The environmental impact analysis and air quality analysis are given. Engineering drawings and specifications are included J D H

N81-23674# Exxon Research and Engineering Co Linden N.J.
Advanced Energy Systems Labs
SOLAR THERMAL ENHANCED OIL RECOVERY (STEOR)
VOLUME 3 PRELIMINARY DESIGN FOR A PRE-HEAT
ONLY SOLAR FACILITY Final Report, 1 Oct 1979 - 30 Jun 1980

Eugene Elzinga Charles Arnold David Allen Robert Garman Patrick Joy, Paul Mitchell, and Henry Shaw Nov 1980 101 p Prepared in cooperation with Foster Wheeler Development Corp Livingston NJ and Honeywell, Inc Minneapolis 3 Vol (Contract DE-AC03-79CS-30307) (SAN-0307-1-Vol-3) Avail NTIS HC A06/MF A01

The preliminary design basis for a solar thermal enhanced oil recovery facility for preheating water supplied to existing boilers is presented. A total of 144 collectors, 6 feet wide and 120 feet long, are required. A projected site layout is given, the design basis specifications, performance estimates, cost estimates and schedule are presented J D H

N81-23675# Sandia Labs, Albuquerque N Mex Experimental
Systems Operation Div
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY
PREDICTIONS FOR THERMAL PERFORMANCE BASED ON
TEST DATA. SOLAR KINETICS T-600 SOLAR COLLECTOR
WITH FEK 244 REFLECTOR SURFACE

Thomas D Harrison Apr 1981 23 p refs (SAND-80-1964/9) Avail NTIS HC A02/MF A01

A program to predict the performance and measure the characteristics of commercially available solar collectors with potential for use in industrial process heat and enhanced oil recovery applications is discussed. The thermal performance predictions for the Solar Kinetics T-600 solar line focusing parabolic trough collector are presented for three output temperatures at five cities in the US DOE

N81-23676# Grumman Aerospace Corp Bethpage N Y
Research Dept
ELECTROCHEMICAL PHOTOVOLTAIC CELLS CdSe THIN
FILM ELECTRODES Final Report, Jun 1979 - Jun 1980

Michael A Russak Joseph Reichman Jerome DeCarlo and Charles Creter Jul 1980 63 p refs (Contract DE-AC02-77CH-00178) (SERI/TR-8002-B-T1 GAC-RE-604) Avail NTIS HC A04/MF A01

Progress on developing stable thin-film CdSe electrodes with sunlight conversion efficiency of 10% for use with aqueous polysulfide electrolytes in frontwall and backwall illuminated EPCs is reported. The main effort was directed towards establishing the relationships among thin-film processing, resultant electronic properties and I-V performance in order to produce electrodes with maximum power conversion efficiency. Films were deposited on titanium at approximately 100 C with a high Se/Cd ratio and then heat treated in air at 350 to 400 C. These films usually have a very fine grained microstructure after heat treatment and the resultant electrodes exhibit fairly square I-V characteristics with fill factors of 0.6 or greater and high current output DOE

N81-23680# Westinghouse Electric Corp East Pittsburgh, Pa
Advanced Systems Technology Div
ECONOMIC ASSESSMENT OF ADVANCED CENTRAL-
RECEIVER SOLAR-THERMAL POWER SYSTEM EXECU-
TIVE SUMMARY

Oct 1980 23 p refs (Contract DE-AC03-79SF-10601) (DOE/SF-10601/T1) Avail NTIS HC A02/MF A01

The impacts of interest included economics, the cost of producing electricity, fuels displaced, and utility system reliability. The central receiver plants evaluated included solar/fossil hybrid concepts and solar stand-alone plants with thermal storage. Liquid metal/molten salt closed Brayton cycle, improved water-steam, and combined Brayton/Rankine cycle concepts were among those investigated DOE

N81-23681# Westinghouse Electric Corp East Pittsburgh Pa
Advanced Systems Technology Div
ECONOMIC ASSESSMENT OF ADVANCED CENTRAL-
RECEIVER SOLAR-THERMAL POWER SYSTEMS Final
Report

John T Day, Roger F Boyle, Michael J Malone, David W Doar and W G Parker Oct 1980 211 p refs

02 SOLAR ENERGY

(Contract DE-AC03-79SF-10601)

(DOE/SF-10601/1) Avail NTIS HC A10/MF A01

The value and potential electric utility impact of several advanced central receiver solar thermal plant concepts in the role of electric generating stations were estimated. The impact of interest included economics, the cost of producing electricity, fuels displaced, and utility system reliability. The central receiver plants evaluated included solar/fossil hybrid concepts and solar stand alone plants with thermal storage. Liquid metal/molten salt, closed Brayton cycle, improved water steam and combined Brayton/Rankine cycle concepts were among those investigated. Detailed modeling of the operation of these plants as they would operate on several electric utility systems, was the basis of the analysis. Analysis to optimize collector area and storage capacity was also performed. The study indicates that if the cost goals can be achieved and predicted solar plant performance attained, then the advanced solar thermal concepts can be competitive in regions with good insolation and some continued use of oil or other surrogate distillate or gaseous fuels. Some thermal storage (3 to 6 hours) was also found to be desirable for most applications. DOE

N81-23682# Westinghouse Electric Corp., East Pittsburgh, Pa. Advanced Systems Technology Div.
ECONOMIC ASSESSMENT OF ADVANCED CENTRAL-RECEIVER SOLAR-THERMAL POWER SYSTEMS PG AND E ASSESSMENT

John T. Day, Roger F. Boyle, and David W. Doar. Jan 1981. 53 p. refs.

(Contract DE-AC03-79SF-10601)

(DOE/SF-10601/2) Avail NTIS HC A04/MF A01

The plants evaluated included solar/fossil hybrid concepts and solar stand-alone plants with thermal storage. Liquid metal/molten salt and combined Brayton/Rankine cycle concepts were investigated. The analysis was based on the operation of the Pacific Gas and Electric system with these plants modeled in detail on the system. Sensitivities to insolation site, collector area and thermal storage were investigated. The study indicates that if the DOE cost goals can be obtained along with the solar plant performance projected, the advanced central-receiver solar-thermal plants investigated can be economically justified on the Pacific Gas and Electric system. DOE

N81-23683# Virginia Polytechnic Inst. and State Univ., Blacksburg.

CdSiAs₂ THIN FILMS FOR SOLAR CELL APPLICATIONS Quarterly Progress Report, 9 Apr - 8 Jul 1980

L. C. Burton. Dec 1980. 16 p. refs. 2. Vol.

(Contract DE-AC02-77CH-00178)

(SERI-9143) Avail NTIS HC A02/MF A01

The best CdSiAs₂ films were obtained from a composite target (CdAs₂ + Si) followed by post-deposition reactive heat treatments. The Perkin-Elmer Randex 2400 8J multitarget sputtering system was installed. Problems related to the J-arm, the RF power generator, RF shielding, water cooling target switches, substrate bias network, vacuum gage controller, graphite heater elements and RF impedance matching network are discussed. Improvements were made in the magnetic field (van der Pauw), spectral response and variable temperature measurement facilities. DOE

N81-23684# Virginia Polytechnic Inst. and State Univ., Blacksburg.

CdSiAs₂ FILMS FOR SOLAR CELL APPLICATIONS Quarterly Progress Report, 9 Jul - 8 Oct 1980

L. C. Burton. Jan 1981. 17 p. refs. 2. Vol.

(Contract DE-AC02-77CH-00178)

(SERI-9143) Avail NTIS HC A02/MF A01

Early problems associated with the Randex multitarget sputtering unit were rectified. CdAs₂, Si, and Cd targets were obtained from commercial vendors. Runs were made using CdAs₂ and Si targets separately. The CdAs₂ deposition rate falls off rapidly with increasing substrate temperature, but performed with CdAs₂ and Si targets. Films on 7059 substrates are amorphous, with composition depending strongly on sputtering parameters. A dual target run made on polished GaAs targets resulted in a crystalline film, although of low Si composition. CdSiAs₂ (211) and (112) peaks were identified in the X-ray spectrum. DOE

N81-23689# Midwest Research Inst., Golden, Colo.

SOLAR THERMAL ELECTRIC POWER INFORMATION USER STUDY

W. W. Belew, B. L. Wood, T. L. Marle, and C. L. Reinhardt. Feb 1981. 194 p. refs.

(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/TR-751-750) Avail NTIS HC A09/MF A01

The results of a series of telephone interviews with groups of users of information on solar thermal electric power are described. These results identified types of information each group needed and the best ways to get information to each group. In the current study only high priority groups were examined. Results from five solar thermal electric power groups of respondents are analyzed. DOE Funded Researchers, Non-DOE-Funded Researchers, Representatives of Utilities, Electric Power Engineers and Educators. DOE

N81-23691# Midwest Research Inst., Golden, Colo.

ACTIVE SOLAR HEATING AND COOLING INFORMATION USER STUDY

W. W. Belew, B. L. Wood, T. L. Marle, and C. L. Reinhardt. Jan 1981. 421 p. refs.

(Contracts DE-AC02-77CH-00178, EG-77-C-01-4042)

(SERI/TR-751-747) Avail NTIS HC A18/MF A01

The results of a series of telephone interviews with groups of users of information on active solar heating and cooling (SHAC) are presented. In the current study only high-priority groups were examined. Results from 19 SHAC groups respondents are analyzed in this report. DOE-Funded Researchers, Non-DOE-Funded Researchers, Representatives of Manufacturers (4 groups), Distributors, Installers, Architects, Educators, Cooperative Extension Service, County Agents, Building Owners/Managers and Homeowners (2 groups). DOE

N81-23693# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

BLOCK 5 SOLAR CELL MODULE DESIGN AND TEST SPECIFICATION FOR INTERMEDIATE-LOAD APPLICATIONS, 1981

20 Feb 1981. 38 p.

(Contract DE-AL01-76CS-31037)

(DOE/CS-31037/T1) Avail NTIS HC A03/MF A01

Intermediate load modules generally having the following design features and characteristics: nominal operating voltage (V sub no) between 5 Vdc and 20 Vdc, ability to be series connected to worst case open circuit voltages of 1000 Vdc, dimensions not exceeding 1.22 m x 2.44 m, flat-plate configurations (non-concentrating) and output power referenced to nominal operating conditions and V sub no. In addition to module design and performance requirements, a series of characterization and qualification tests are also specified. DOE

N81-23696# Oklahoma State Univ., Stillwater. School of Mechanical and Aerospace Engineering.

PERFORMANCE MONITORING OF GROUND-COUPLED SOLAR-ASSISTED HEAT PUMP SYSTEMS Interim Report

J. D. Parker and B. Frierson. Feb 1981. 37 p. Prepared for Electric Power Research Inst. Prepared in cooperation with Oklahoma Gas and Electric Co., Oklahoma City. (EPRI Proj. 1191-6)

(EPRI-EM-1697) Avail NTIS HC A03/MF A01

Three Oklahoma Gas and Electric Company demonstration houses in Perkins, Oklahoma, and the data acquisition systems are described. The project involves comparison of the performance of a ground-coupled solar-assisted heat pump system with that of a ground coupled heat pump system without solar assist, and with a conventional air source heat pump system. Details of the data acquisition and processing system are given. Problems encountered and anticipated are discussed. DOE

N81-23698# Harvard Univ., Cambridge, Mass. Energy and Environment Policy Center.

ASSESSMENT OF THE SOLAR HEATING AND COOLING IN RESIDENTIAL BUILDING DEMONSTRATION PROGRAM Interim and Final Report

D. Craig Wolff. Aug 1980. 21 p. refs.

(Contract DE-AC01-80PE-70278)

(DOE/PE-70278/T10) Avail NTIS HC A02/MF A01

The Solar Heating and Cooling in Residential Building Demonstration of 1974 is assessed. The program's goals and

the Government Accounting Office's (GAO) evaluation of the program's success are stated. The program is analyzed with regard to objectives, results, data, and the GAO's conclusions. The differing approaches of the GAO and the Department of Housing and Urban Development to the program are analyzed and compared, showing weaknesses in each. Conclusions on the relative success of the program are drawn, and recommendations are made regarding any future programs of this type. DOE

N81-23702# Sandia Labs., Albuquerque, N. Mex.
SOLAR ENHANCED OIL RECOVERY: A POTENTIAL EARLY MARKET FOR INDUSTRIAL SOLAR ENERGY
 Kenneth D. Bergeron and Virgil L. Dugan. 1980. 12 p. refs.
 Presented at the Natl. Conf. on Renewable Energy Technol., Honolulu, Hawaii, 7 Dec 1980.
 (Contract DE-AC04-76DP-00789)
 (SAND-80-1869C, CONF-801203-5) Avail. NTIS HC A02/MF A01

Enhanced oil recovery and the possibility of using solar energy to replace current methods are discussed. The market potential for solar enhanced oil recovery is explored. DOE

N81-23705# Sandia Labs., Albuquerque, N. Mex. Experimental Systems Operations Div.
THE COOLIDGE SOLAR IRRIGATION PROJECT: Annual Report, 1980
 Leroy Torkelson and Dennis L. Larson. Feb. 1981. 148 p. Prepared in cooperation with Arizona Univ., Tucson.
 (Contract DE-AC04-76DP-00789)
 (SAND-80-2378) Avail. NTIS HC A07/MF A01

The solar irrigation facility consists of a 2136.8 m² (23,000 ft²) line-focus parabolic trough collector subsystem, a 113.55 m³ (30,000 gallon) thermal storage subsystem, and a 150 kW/sub e/ (142.2 Btu/s) organic Rankine cycle power generation unit. The performance of the facility and its operational and maintenance requirements are reported. The period from the facility's initial operation in October 1979 to 31 August 1980 is covered. DOE

N81-23709# National Bureau of Standards, Washington, D.C. National Engineering Lab.
SOLAR ENERGY SYSTEMS: STANDARDS FOR COVER PLATES FOR FLAT PLATE SOLAR COLLECTORS: Final Report
 Elizabeth J. Clark, Willard E. Roberts, John W. Grimes, and Edward J. Embree. Dec. 1980. 161 p. refs. Sponsored in part by DOE, Washington, D.C.
 (PB81-147290, NBS-TN-1132) Avail. NTIS HC A08/MF A01 CSCL 10A

Laboratory studies were performed to obtain data needed for the development of standards to evaluate the performance and durability of cover plates for flat plate solar collectors used in solar heating and cooling systems. Ten cover plate materials were evaluated to assess their durability after exposure to heat, aging, natural weathering, and accelerated weathering. Laboratory tests included measurement of solar energy transmittance, linear dimensional stability, warpage, and the effect of dirt retention. The temperatures cover plate materials attain on solar collectors were determined by measurement and by computer simulations. A procedure was developed for the natural weathering exposure of cover plate materials at elevated temperatures which approximate stagnation conditions of solar collectors. The results of the laboratory tests are presented and draft standards for evaluating cover plate materials for flat plate solar collectors are proposed. GRA

N81-23988# Technical Research Analysis Co., Falls Church, Va.
DEVELOPMENT OF A MARKET METHODOLOGY FOR ASSESSING THE IMPACT OF SOLAR THERMAL-PRODUCED FUELS AND CHEMICALS
 Christina A. Swanson. 17 Nov. 1980. 50 p. refs.
 (Contract DE-AP03-80SF-12989)
 (DOE/SF-12989/1) Avail. NTIS HC A03/MF A01

An attempt was made to determine the potential impacts on the solar thermal industry and on the markets for particular fuels and chemicals of applying solar thermal technology to the production of these fuels and chemicals. The following are covered: the technical compatibility of Solar Thermal Fuels and Chemicals (ST/FC) processes, the identification of promising ST/FC

processes, technical specification and economic evaluation of selected systems, ST/FC market assessments, and identification of strategic options. An overview is presented of oil shale resources, economics, and industry development, and of issues significant to the potential application of solar thermal technology in oil shale retorting. DOE

N81-24230*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
METHOD FOR DEPOSITING AN OXIDE COATING: Patent Application
 G. E. McDonald, inventor (to NASA). Filed 23 Mar. 1981. 8 p.
 (NASA-Case-LEW-13131-1, US-Patent-Appl-SN-246772) Avail. NTIS HC A02/MF A01 CSCL 11F

A metal oxide coating is plated onto a metal substrate at the cathode from an acid solution which contains an oxidizing agent. The process is particularly useful for producing solar panels. Conventional plating at the cathode avoids the presence of oxidizing agents. Coatings made in accordance with the invention are stable both at high temperatures and while under the influence of high photon flux in the visible range. NASA

N81-24520* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SOLAR TRACKING SYSTEM: Patent
 Paul R. White and Donald R. Scott, inventors (to NASA). Issued 14 Apr. 1981. 6 p. Filed 25 Jul. 1979. Supersedes N79-28667 (17 - 19, p. 2567).
 (NASA-Case-MFS-23999-1, US-Patent-4,262,195, US-Patent-Appl-SN-060435, US-Patent-Class-250-203R, US-Patent-Class-250-209) Avail. US Patent and Trademark Office CSCL 10A

A solar tracker for a solar collector is described in detail. The collector is angularly oriented by a motor wherein the outputs of two side-by-side photodetectors are discriminated as to three ranges: a first corresponding to a low light or darkness condition, a second corresponding to light intensity lying in an intermediate range, and a third corresponding to light above an intermediate range, direct sunlight. The first output drives the motor to a selected maximum easterly angular position, the second enables the motor to be driven westerly at the Earth rotational rate, and the third output, the separate outputs of the two photodetectors, differentially controls the direction of rotation of the motor to effect actual tracking of the Sun. Official Gazette of the U.S. Patent and Trademark Office

N81-24523 Minnesota Univ., Minneapolis.
AN INVESTIGATION OF THE CONTOURED-OXIDE MONOLITHIC SERIES-ARRAY SOLAR BATTERY: Ph.D. Thesis
 Eileen Marie Murray. 1980. 86 p.
 Avail. Univ. Microfilms Order No. 8109479

The contoured-oxide monolithic series-array solar battery (MSASB) uses dielectric isolation to separate the individual cells of the array which offers an improvement in cell response uniformity over previous MSASB designs. The devices discussed exhibited array power conversion efficiencies of 7.5 percent which was attributed in part to high series resistance caused by a process omission. In addition, it was determined that shunting due to poor device isolation was a problem. Modifications to this process for improved array response are detailed and array optimization for maximum output power is analyzed. The loss mechanisms are considered. Area losses are composed of interconnect area, area shaded by front-grid contacts and area devoted to any needed circuitry. An evaluation of this problem, yielding the optimum number of cells, is presented. Dissert. Abstr.

N81-24524 Utah Univ., Salt Lake City.
INVESTIGATION OF SALT STRATIFIED SOLAR POND OPERATIONAL CHARACTERISTICS: Ph.D. Thesis
 Ty Allan Newell. 1980. 245 p.
 Avail. Univ. Microfilms Order No. 8109565

Operational characteristics and economic feasibility of the salt stratified solar pond are examined. A one-dimensional transient numerical model is developed which offers flexibility for pond property specifications, thermal energy performance prediction, and thermal energy extraction uses. Stability of the gradient zone of a salt stratified pond is one of the most important areas of pond operational feasibility. A criterion for the operational state of a solar pond which constrains the allowable salinity and temperature profiles is developed and extended for use as

02 SOLAR ENERGY

a design tool for solar ponds The decanting method of thermal energy extraction is most feasible for large scale ponds A two dimensional numerical fluid dynamics program has been developed for this purpose and examines the effect of inlet and outlet jet placement in the storage zone of a pond A simple laboratory experiment for qualitative investigations of solar pond phenomena is described
Dissert Abstr

N81-24527*# Union Carbide Corp, New York
LOW COST SOLAR ARRAY PROJECT EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT FOR PRODUCING SEMICONDUCTOR-GRADE SILICON USING SILANE-TO-SILICON PROCESS Quarterly Progress Report, Oct - Dec 1980

Dec 1980 109 p refs Sponsored by DOE Prepared for JPL (Contract JPL-954334)
(NASA-CR-164342 DOE/JPL-954334-17 JPL-9950-531)
Avail NTIS HC A06/MF A01 CSCL 10A

The design, fabrication, and installation of an experimental process system development unit (EPSDU) were analyzed Supporting research and development were performed to provide an information data base usable for the EPSDU and for technological design and economical analysis for potential scale-up of the process Iterative economic analyses were conducted for the estimated product cost for the production of semiconductor grade silicon in a facility capable of producing 1000-MT/Yr

RCT

N81-24530*# DHR, Inc Washington, D C
MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS IN THE PHILIPPINES Final Report

R Anil Cabraal David Delasanta and George Burrill (Associates in Rural Development Inc Burlington, Vt) Apr 1981 205 p refs

(Contract DEN3-180, DE-AIO1-79ET-20485)
(NASA-CR-165286, DOE/NASA/O180-1, C4100-50) Avail
NTIS HC A10/MF A01 CSCL 10A

The market potential in the Philippines for stand alone photovoltaic (P/V) systems in agriculture was assessed Applications include irrigation postharvest operation, food and fiber processing and storage, and livestock and fisheries operations Power and energy use profiles for many applications as well as assessments of business government and financial climate for P/V sales are described Many characteristics of the Philippine agriculture and energy sector favorably influence the use of P/V systems However, serious and significant barriers prevent achieving the technically feasible cost competitive market for P/V systems in the agricultural sector The reason for the small market is the limited availability capital for financing P/V systems It is suggested that innovative financing schemes and promotional campaigns should be devised

EAK

N81-24531*# IBM Federal Systems Div, Huntsville, Ala
SOLAR ENERGY SYSTEM ECONOMIC EVALUATION IBM SYSTEM 4, CLINTON, MISSISSIPPI Final Report

Sep 1980 101 p refs
(Contract NAS8-32036)
(NASA-CR-161726) Avail NTIS HC A06/MF A01 CSCL 10A

An economic analysis of the solar energy system was developed for five sites, typical of a wide range of environmental and economic conditions in the continental United States The analysis was based on the technical and economic models in the F-chart design procedure, with inputs based on the characteristics of the installed system and local conditions The results are of the economic parameters of present worth of system cost over a 20 year time span life cycle savings, year of positive savings and year of payback for the optimized solar energy system at each of the analysis sites The sensitivity of the economic evaluation to uncertainties in constituent system and economic variables is also investigated

EAK

N81-24532*# IBM Federal Systems Div Huntsville, Ala
SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FERN TUNKHANNOCK, TUNKHANNOCK, PENNSYLVANIA Final Report

Sep 1980 99 p refs
(Contract NAS8-32036)
(NASA-CR-161723) Avail NTIS HC A05/MF A01 CSCL 10A

Economic performance of an Operational Test Site (OTS) is

described The long term economic performance of the system at its installation site and extrapolation to four additional selected locations to demonstrate the viability of the design over a broad range of environmental and economic conditions is reported Topics discussed are system description, study approach, economic analysis and system optimization, and technical and economical results of analysis Data for the economic analysis are generated through evaluation of the OTS The simulation is based on the technical results of the seasonal report simulation In addition localized and standard economic parameters are used for economic analysis
EAK

N81-24537*# Jet Propulsion Lab California Inst of Tech Pasadena

SENSITIVITY ANALYSIS OF THE ADD-ON PRICE ESTIMATE FOR THE EDGE-DEFINED FILM-FED GROWTH PROCESS

Anant R Mokashi and Akaram H Kachare 15 Mar 1981 36 p refs Sponsored by NASA Prepared for DOE (JPL Proj 5101-171)

(NASA-CR-164358, JPL-Pub-81-37, DOE/JPL-1012-55) Avail
NTIS HC A03/MF A01 CSCL 10A

The analysis is in terms of cost parameters and production parameters The cost parameters include equipment space, direct labor, materials, and utilities The production parameters include growth rate, process yield, and duty cycle A computer program was developed specifically to do the sensitivity analysis
TM

N81-24538*# Jet Propulsion Lab California Inst of Tech, Pasadena

HIGH-EFFICIENCY THIN-FILM GaAs SOLAR CELLS, PHASE 2 Final Report, 1 Jul 1979 - 30 Jan 1981

Y C M Yeh 15 Mar 1981 101 p refs Sponsored by DOE (NASA-CR-164361, JPL-Pub-81-33) Avail NTIS HC A06/MF A01 CSCL 10A

Thin GaAs epi-layers with good crystallographic quality were grown using a (100) Si-substrate on which a thin Ge epi-interlayer was grown by CVD from germane Both antireflection-coated metal oxide semiconductor (AMOS) and n(+)/p homojunction structures were studied The AMOS cells were fabricated on undoped-GaAs epi-layers deposited on bulk poly-Ge substrates using organo-metallic CVD film-growth, with the best achieved AM1 conversion efficiency being 9.1% Both p-type and n(+)-type GaAs growth were optimized using 50 ppm dimethyl zinc and 1% hydrogen sulfide, respectively A direct GaAs deposition method in fabricating ultra-thin top layer epitaxial n(+)/p shallow homojunction solar cells on (100) GaAs substrates (without anodic thinning) was developed to produce large area (1 sq/cm) cells with 19.4% AM1 conversion efficiency achieved Additionally, an AM1 conversion efficiency of 18.4% (17.5% with 5% grid coverage) was achieved for a single crystal GaAs n(+)/p cell grown by OM-CVD on a Ge wafer
JMS

N81-24540*# Spectrolab Inc, Sylmar, Calif
PILOT PRODUCTION AND TESTING OF HIGH EFFICIENCY WRAPAROUND CONTACT SOLAR CELLS Final Report, May 1979 - Mar. 1981

M Gillanders Jun 1981 44 p refs
(Contract NAS3-21270)
(NASA-CR-165302) Avail NTIS HC A03/MF A01 CSCL 10A

Modifications were made to the process sequence until a device capable of high performance and satisfactory processing yields could be fabricated on a production line Pilot production resulted in a 2 x 4 cm screen printed dielectric wraparound contact solar cell with average 28 C Air Mass Zero (AMO) conversion efficiencies of 14.2% and reasonable process yields This high performance was obtained with two different back contact configurations making the device acceptable for many applications
TM

N81-24541*# International Business Machines Corp Huntsville, Ala Federal Systems Div

SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FOR IBM SYSTEM 3, GLENDO, WYOMING Final Report

Sep 1980 102 p refs Sponsored in part by DOE (Contract NAS8-32036)
(NASA-CR-161728) Avail NTIS HC A06/MF A01 CSCL 10B

This analysis was based on the technical and economic models in f-chart design procedures with inputs based on the characteristics of the parameters of present worth of system cost over a

projected twenty year life cycle savings year of positive savings and year of payback for the optimized solar energy system at each of the analysis sites. The sensitivity of the economic evaluation to uncertainties in constituent system and economic variables was also investigated. T M

N81-24546# Coast Guard Research and Development Center, Groton, Conn

TESTING OF SOLAR PHOTOVOLTAIC ARRAYS FOR UTILIZATION ON MARINE AIDS TO NAVIGATION Interim Report

S E Trenchard Nov 1980 72 p refs (AB-A098257 CGR/DC-13/80 UACG-D-10-51) Avail NTIS HC A04/MF A01 CSCL 10/2

In 1978, approximately 400 solar photovoltaic arrays were procured and placed at marine exposure facilities in Groton Connecticut and Fort Lauderdale Florida. The arrays were measured quarterly to ascertain the effects of the marine environment on electrical performance. Concurrently, a screening test for photovoltaic arrays to be used in the marine environment was developed at the Coast Guard R and D Center. Identical panels to those on test at the exposure sites were run through the pressure, immersion, and temperature (PIT) screening test. Based on the marine environment exposure test and the PIT screening test, recommendations are made on the constituent materials and construction techniques of solar photovoltaic arrays that are most suited for use in the marine environment.

Author (GRA)

N81-24548# Rockwell International Corp., Anaheim, Calif Electronic Devices Div

THIN FILMS OF GALLIUM ARSENIDE ON LOW-COST SUBSTRATES Final Technical Report, 5 Jul 1976 - 5 Dec 1978

R P Ruth, P D Dapkus, R D Dupuis, R E Johnson L A Moudy, J J Yang, and R D Yingling Mar 1980 104 p refs (Contract DE-AC03-76ET-20435) (SAN-1202-8) Avail NTIS HC A06/MF A01

The metalorganic chemical vapor deposition (MO-CVD) technique was applied to the growth of thin films of GaAs and GaAlAs on inexpensive polycrystalline or amorphous substrate materials. The properties of grain boundaries in polycrystalline GaAs films were studied by the use of transport measurements as a function of temperature. Schottky barrier solar cells of approximately 3 percent efficiency were demonstrated on various substrates. Substantial enhancement of average grain size in polycrystalline GaAs films on Mo sheet was obtained. Investigation of polycrystalline thin-film p-n junctions indicated that the forward voltage of such devices is apparently limited to 0.5 to 0.6 V. A laboratory-type deposition apparatus for the formation of TiO₂ antireflection coatings was assembled and tested. Detailed analyses were made of the materials and labor costs involved in the laboratory-scale fabrication of MO-CVD thin-film GaAs solar cells. DOE

N81-24557# Water and Power Resources Service, Denver, Colo **SOLAR/HYDRO INTEGRATION**

Jul 1980 68 p refs (Contract DE-AI03-79SF-10505) (DOE/SF-10505/3) Avail NTIS HC A04/MF A01

Objectives were (1) determine the technical and economic viability of integrating solar central receiver with the Federal hydroelectric system in the Lower Colorado Region of the Service, and (2) recommend a prime site and an implementation plan for a feasibility study. Two candidate solar receiver systems are considered. Both are of the Advanced Central Receiver design each utilizing a central power tower surrounded by a field of two-axis tracking mirrors (heliostats). The principal difference between the two systems is that one uses a molten salt as its heat transfer fluid whereas the other system uses liquid sodium. A description of the Federal hydroelectric power system is given, and a projection of the energy needs for the Lower Colorado service area is presented. Details of the site selection, solar plant evaluation, solar/weather data analysis, energy analysis, integration analysis, economic analysis, environmental analysis, and implementation plan are reported. DOE

N81-24563# Brookhaven National Lab., Upton, N Y Dept of Energy and Environment

GROUND COUPLED SOLAR HEAT PUMPS. ANALYSIS OF FOUR OPTIONS

J W Andrews 1981 14 p refs Presented at the 3rd Ann Systems Simulation Econ Anal Solar Heating and Cooling Operational Results Conf Reno Nev 27 Apr - 1 May 1981 (Contract DE-AC02-76CH-00016) (BNL-29007 CONF-810405-12) Avail NTIS HC A02/MF A01

Heat pump systems which utilize both solar energy and energy withdrawn from the ground are analyzed using a simplified procedure which optimizes the solar storage temperature on a monthly basis. Four ways of introducing collected solar energy to the system are optimized and compared. These include use of actively collected thermal input of the heat pump, use of collected solar energy to heat the load directly (two different ways), and use of a passive option to reduce the effective heating load. DOE

N81-24568# Lincoln Lab Mass Inst of Tech Lexington **SOLAR PHOTOVOLTAIC POWER SYSTEM FOR A RADIO STATION**

Burt E Nichols Dec 1980 20 p refs (Contract DE-AC02-76ET-20279) (COO-4094-85) Avail NTIS HC A02/MF A01

Of simple construction the system uses low-cost prefabricated, transportable units for easy, fast installation and requires minimal site preparation. The first application of this experimental system began operation in August 1979 at daytime AM radio station WNBO in Bryan, Ohio. The project was jointly undertaken by the Laboratory and the radio station. The photovoltaic system described holds promise for a wide range of applications and economic feasibility by the mid to late 1980s. DOE

N81-24569# California Univ., Berkeley Lawrence Berkeley Lab Solar Energy Group

INTERACTION OF A SOLAR SPACE HEATING SYSTEM WITH THE THERMAL BEHAVIOR OF A BUILDING

Christian Vilmer Mashun Warren L and David Auslander Dec 1980 13 p refs Presented at the ASME Solar Energy Div Conf on Systems Simulation Econ Analysis/Solar Heating and Cooling Operational Results Reno Nev 27 Apr - 1 May 1981

(Contract W-7405-eng-48) (LBL-11673 CONF-810405-4) Avail NTIS HC A02/MF A01

The thermal behavior of a building in response to heat input from an active solar space heating system is analyzed to determine the effect of the variable storage tank temperature on the cycling rate, on-time and off-time of a heat cycle and on the comfort characteristics of room air temperature swing and of offset of the average air temperature from the setpoint (droop). A simple model of a residential building a fan coil heat-delivery system and a bimetal thermostat are used to describe the system. A computer simulation of the system behavior was developed and verified. The system model and simulation are then applied to determine the building response to a typical hydronic solar heating system for different solar storage temperatures outdoor temperatures and fan coil sizes. DOE

N81-24570# Bendix Corp Kansas City Mo **ANALYTICAL MODEL AND PERFORMANCE DATA FOR A CYLINDRICAL PARABOLIC COLLECTOR**

F M Ford and W E Stewart, Jr (Missouri Univ Kansas City) 1980 14 p refs Presented at the 3rd Miami Intern Conf on Alternative Energy Sources Miami Beach Fla, 15-17 Dec 1980

(Contract DE-AC04-76DP-00613) (BDX-613-2559, CONF-801210-17) Avail NTIS HC A02/MF A01

Concentrating solar collectors provide higher fluid temperatures than flat plate an important advantage in many applications. The parabolic cylinder is one of the most popular types of concentrating collectors because of its relatively simple construction and tracking configurations. A mathematical model was developed for one such collector in order to predict thermal efficiency as a function of solar insolation. An experiment was then devised in an attempt to verify this model. Discrepancies between predicted and observed values are discussed, and suggestions are made for improving the model and the experimental procedure. DOE

N81-24571# Lincoln Lab Mass Inst of Tech Lexington **PERFORMANCE OF A COMBINED PHOTOVOLTAIC/**

02 SOLAR ENERGY

THERMAL FLAT-PLATE, LIQUID COLLECTOR

W A Aiello and P Raghuraman 1981 8 p refs Presented at the 3rd Ann Systems Simulation Econ Anal Solar Heating and Cooling Operational Results Conf Reno, Nev 28 Apr - 1 May 1981
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/111, CONF-810405-3) Avail NTIS HC A02/MF A01

A combined photovoltaic/thermal (PV/T) flatplate, liquid collector, where the liquid circulates both below and above the photovoltaic cells (the primary energy-absorbing surface), was designed and tested specifications to yield collector thermal and electrical efficiencies A one dimensional thermal analysis predicts the test results accurately On the strength of the test and analytical results design recommendations are made to maximize the total energy extracted from the collectors DOE

N81-24572# Los Alamos Scientific Lab N Mex Solar Energy Group

SOLAR PONDS AS A SOURCE OF LOW TEMPERATURE HEAT

D A Neeper and K A Meyer 1981 8 p refs Presented at the 8th Energy Technol Conf and Exposition, Washington, D C, 9-11 Mar 1981
(Contract W-7405-eng-36)
(LA-UR-81-485, CONF-810315-1) Avail NTIS HC A02/MF A01

Salt-gradient solar ponds are potentially attractive for electric power generation The progress of salt-gradient solar pond development, both in the United States and abroad is reviewed Technical problem areas and their implications for commercialization are discussed Potential market applications for solar ponds are examined DOE

N81-24573# Midwest Research Inst, Golden Colo
SECOND THERMAL STORAGE APPLICATIONS WORKSHOP

Charles E Wyman and Ronal W Larson Jun 1980 87 p Workshop held at San Antonio 7-8-Feb 1980
(Contracts EG-77-C-01-4042, DE-AC02-77CH-00178)
(SERI/TP-333-605 CONF-800266) Avail NTIS HC A05/MF A01

On February 7 and 8 1980, approximately 20 persons representing the management of both the Solar Thermal Power Systems Program (TPS) of the US Department of Energy (DOE) Division of Central Solar Technology (CST) and the Thermal Energy Storage Program (TES) of the DOE Division of Energy Storage Systems (STOR) met to review the joint Thermal Energy Storage for Solar Thermal Applications (TESSTA) Program and to discuss issues in implementing it Summaries of the seven major elements of the joint program (six receiver-related, storage development elements, and one advanced technology element are presented DOE

N81-24585*# IBM Federal Systems Div Huntsville Ala
SOLAR ENERGY SYSTEM ECONOMIC EVALUATION CONTEMPORARY NEWMAN, GEORGIA Final Report

Sep 1980 102 p refs
(Contract NAS8-32036)
(NASA-CR-161727) Avail NTIS HC A06/MF A01 CSCL 10A

An economic evaluation of performance of the solar energy system (based on life cycle costs versus energy savings) for five cities considered to be representative of a broad range of environmental and economic conditions in the United States is discussed The considered life cycle costs are hardware, installation maintenance and operating costs for the solar unique components of the total system The total system takes into consideration long term average environmental conditions, loads, fuel costs, and other economic factors applicable in each of five cities Selection criteria are based on availability of long term weather data, heating degree days, cold water supply temperature solar insolation, utility rates, market potential, and type of solar system E A K

N81-24587# Wack (Oskar K) Chemie G m b H, Ingolstadt (West Germany)

CLEANING SYSTEM FOR SOLAR ENERGY COLLECTORS Final Report

Oskar K Wack Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 30 p In GERMAN ENGLISH summary

Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-045 ISSN-0340-7608) Avail NTIS HC A03/MF A01

Reduction of light transmission caused by soiling of solar energy collectors was measured under laboratory conditions The magnitude of possible energy losses was determined Glass slides (30 X 55mm) were soiled with three different test dirt The energy losses vary between 9% and 20%, depending on soil load (0.4 to 0.9 g/sq m) and soil type Given the significance of these results their verification by testing glass surfaces soiled under outdoor conditions is proposed The development of a prototype automatic cleaning system for solar energy collectors is also suggested A literature search shows no reference to research on the soiling problem of solar energy collectors

Author (ESA)

N81-24590# Fachhochschule, Esslingen (West Germany) Labor fuer Lueftungs- und Klimatechnik

A SOLAR ENERGY SYSTEM AS A COMPLEMENT TO A CONVENTIONAL HEATING SYSTEM MEASUREMENT OF THE STORAGE AND CONSUMPTION OF SOLAR ENERGY Final Report

Ernst Doering and Willi Lippe Bonn Bundesministerium fuer Forschung und Technologie Sep 1980 51 p In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-079 ISSN-0340-7608) Avail NTIS HC A04/MF A01

A residential house, having a fuel oil based heating system (radiators and floor heating domestic hot water) was equipped with a solar energy conversion plant which supplemented the water heating system Total insolation, the energy received by the solar collectors, and energy consumption for heating and domestic hot water were monitored Results show the collector system to have a conversion efficiency of 15.4% The solar energy system contribution to overall energy consumption was 6.1% Improvement of the solar energy plant is discussed Suggestions include enlarging the collector surface alteration of the regulation scheme, utilization of thermal stratification in the conception of solar heat storage better insulation of conduit pipes, and avoidance of shadowing the collectors Author (ESA)

N81-24592# Man-Turbomotoren G m b H, Munich (West Germany) Neue Technologie

DEVELOPMENT OF AN ECONOMIC SOLAR HEATING SYSTEM WITH COST EFFICIENT FLAT PLATE COLLECTORS Final Report

Waldburg Eder-Milchgeisser and Roland Burkart Bonn Bundesministerium fuer Forschung und Technologie Oct 1980 24 p In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-113, ISSN-0340-7608) Avail NTIS HC A02/MF A01

Mass produced flat plate solar collectors were worked into the design of a system for heating a swimming pool and/or providing domestic hot water The collector characteristics including physical and mechanical data as well as theoretical energy conversion efficiency, are presented The collector was tested and service life efficiency was determined The mounting of the collector depending on roof type, is explained Both in service and laboratory test results demonstrate the cost effectiveness of the system Further improvement of efficiency is envisaged with automatic flow control in the solar collector and hot water circuits Author (ESA)

N81-24999# Battelle Southern Operations, Atlanta, Ga
REPLICATION AND EVALUATION OF SELECTED INNOVATIONS DEVELOPED WITHIN THE URBAN TECHNOLOGY SYSTEM REPORT 2 CASE STUDIES Final Report

J Mercer 1980 32 p 3 Vol
(Grant NSF ISP-77-13029)
(PB81-134744, NSF/RA-800261, Rept-2) Avail NTIS HC A03/MF A01, Also available in set of 3 reports HC E08 as PB81-134728-SET CSCL 05A

Case studies are presented which illustrate the transfer of three innovations to six local government jurisdictions The following combinations are evaluated project control system to Lincoln, Nebraska and East Point, Georgia, solar hot water heating to Middletown, Ohio and Austin, Texas, and telephone cost control to Denton, Texas and Chesterfield County, Virginia GRA

N81-25122*# Rensselaer Polytechnic Inst Troy, N Y Dept of Electrical Computer and Systems Engineering
SPS FLEXIBLE SYSTEM CONTROL ASSESSMENT ANALYSIS Final Report

Mark J Balas 15 Mar 1981 163 p refs
 (Contract NAS9-16053)
 (NASA-CR-160962) Avail NTIS HC A08/MF A01 CSCL 22B

Active control of the Satellite Power System (SPSO) a large mechanically flexible aerospace structure is addressed. The control algorithm is the principle component in the feedback link from sensors to actuators. An analysis of the interaction of the SPS structure and its active control system is presented. E A K

N81-25137*# Astro Research Corp Carpinteria Calif
CONCEPTUAL DESIGN STUDIES FOR LARGE FREE-FLYING SOLAR-REFLECTOR SPACECRAFT

John M Hedgepeth, Richard K Miller, and Karl pop Washington Knapp NASA Jun 1981 125 p refs

(Contract NAS1-15347)
 (NASA-CR-3438 ARC-R-1015) Avail NTIS HC A06/MF A01 CSCL 22B

The 1 km diameter reflecting film surface is supported by a lightweight structure which may be automatically deployed after launch in the Space Shuttle. A twin rotor, control moment gyroscope with deployable rotors, is included as a primary control actuator. The vehicle has a total specific mass of less than 12 g/sq m including allowances for all required subsystems. The structural elements were sized to accommodate the loads of a typical SOLARES type mission where a swarm of these free flying satellites is employed to concentrate sunlight on a number of energy conversion stations on-the ground. T M

N81-25491*# Department of Energy Washington D C
SOLAR HEATING AND HOT WATER SYSTEM INSTALLED AT ALDERSON BROADBUSH COLLEGE, PHILIPPI, WEST VIRGINIA Final Technical Report

May 1981 89 p
 (Contract EM-78-F-01-5228)
 (NASA-CR-161756) Avail NTIS HC A05/MF A01 CSCL 10A

Data needed necessary to evaluate the design and operation of a solar energy heating and hot water system installed in a commercial application are presented. The information includes system descriptions, acceptance test data, schematics as built, drawing problems encountered, all solutions and photographs of the system at various stages of completion. A R H

N81-25494*# California Inst of Tech Pasadena
STUDY OF THE EFFECTS OF IMPURITIES ON THE PROPERTIES OF SILICON MATERIALS AND PERFORMANCE OF SILICON SOLAR CELL Annual Technical Report

C T Sah Mar 1981 30 p refs Sponsored in part by NASA and DOE
 (Contract JPL-954685)
 (NASA-CR-164452 JPL-9950-54 DOE/JPL-954685-81/4 ATR-4) Avail NTIS HC A03/MF A01 CSCL 10A

The effect of silicon film thickness on the energy conversion efficiency of a back surface field solar cell is investigated. A computer-aided design study on the dependence of efficiency peaks on the concentrations of the recombination and dopant impurities is presented. The illuminated current voltage characteristics of over 100 cell designs were obtained using the transmission line circuit model to numerically solve the Shockley Equations. Using an AM1 efficiency of 17% as a target value, it is shown that the efficiency versus thickness dependence has a broad maximum which varies less than 1% over more than three-to-one range of cell thickness from 30 to 100 microns. Optical reflecting back surface will give only a slight improvement of AM1 efficiency, about 0.7%, in this thickness range. The sensitive dependence of efficiency on patchiness across the back surface field, low high junction in thin cells is noted. J D H

N81-25496*# Mobil Tyco Solar Energy Corp Waltham, Mass
LARGE AREA SILICON SHEET BY EFG Quarterly Report, 1 Jan - 31 Mar 1981
 29 May 1981 45 p refs Sponsored by NASA and DOE
 Prepared for JPL
 (Contract JPL-954355)

(NASA-CR-164449, DOE/JPL-954355-81/17) Avail NTIS HC A03/MF A01 CSCL 10A

A multiple growth run with three 10 cm cartridges was carried out with the best throughput rates and time percentage of simultaneous three ribbon growth achieved to date in this system. Growth speeds were between 3.2 and 3.6 cm/minute on all three cartridges and simultaneous full width growth of three ribbons was achieved 47 percent of the time over the eight hour duration of the experiment. Improvements in instrumentation and in the main zone temperature uniformity were two factors that have led to more reproducible growth conditions in the multiple ribbon furnace. T M

N81-25501*# General Electric Co., Philadelphia, Pa Advanced Energy Programs Dept
INTEGRATED RESIDENTIAL PHOTOVOLTAIC ARRAY DEVELOPMENT Quarterly Report

N F Shepard, Jr 18 May 1981 90 p Sponsored by NASA and DOE Prepared for JPL

(Contract JPL-955894)
 (NASA-CR-164447, DOE/JPL-955894-2) Avail NTIS HC A05/MF A01 CSCL 10A

Three basic module design concepts were analyzed with respect to both production and installation costs. The results of this evaluation were used to synthesize a fourth design which incorporates the best features of these initial concepts to produce a module/array design approach which offers the promise of a substantial reduction in the installed cost of a residential array. A unique waterproofing and mounting scheme was used to reduce the cost of installing an integral array while still maintaining a high probability that the installed array will be watertight for the design lifetime of the system. This recommended concept will also permit the array to be mounted as a direct or stand-off installation with no changes to the module design. T M

N81-25508*# Honeywell Systems and Research Center, Minneapolis Minn

SPECTROPHOTOVOLTAIC ORBITAL POWER GENERATION Progress Report

Gary Knowles, Dave Stoltzman, Ray Lin and Sau Kwan Lo 18 Dec 1980 59 p
 (Contract NAS8-33511)
 (NASA-CR-161795) Avail NTIS HC A04/MF A01 CSCL 10A

A system with 1000:1 concentration ratio is defined, using a cassegrain telescope as the first stage concentration (270 x) and compound parabolic concentrators (CPC) for the second stage concentration of 4.7 x for each spectral band. Using reported state of the art (S O A) solar cells device parameters and considering structural losses due to optics and beamsplitters, the efficiencies of one to four cell systems were calculated with efficiencies varying from approximately 22% to 30%. Taking into account cost of the optics, beamsplitter radiator, and the cost of developing new cells, the most cost effective system is the GaAs/Si system. T M

N81-25510*# IBM Federal Systems Div., Huntsville, Ala
SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FOR SEECO LINCOLN, LINCOLN, NEBRASKA Final Report

Sep 1980 97 p refs Sponsored in part by DOE
 (Contract NAS8-32036)
 (NASA-CR-161724) Avail NTIS HC A05/MF A01 CSCL 10A

The economic analysis of the solar energy system that was installed at Lincoln, Nebraska is developed for this and four other sites typical of a wide range of environmental and economic conditions in the continental United States. This analysis is accomplished based on the technical and economic models in the f chart design procedure with inputs based on the characteristics of the installed system and local conditions. The results are expressed in terms of the economic parameters of present worth of system cost over projected twenty year life, life cycle savings, year of positive savings and year of payback for the optimized solar energy system at each of the analysis sites. The sensitivity of the economic evaluation to uncertainties in constituent system and economic variables is also investigated. Author

N81-25514# Midwest Research Inst., Golden, Colo
DEVELOPMENT OF HIGH-EFFICIENCY CASCADE SOLAR

02 SOLAR ENERGY

CELLS

Jan 1981 25 p refs

(Contract DE-AC02-77CH-00178)

(SERI/PR-8136-1-T2 TPR-4) Avail NTIS HC A02/MF A01

The technology required to fabricate two junction cascade solar cells having conversion efficiencies of 30 percent or more under multisun illumination is being developed. An intermediate objective is to demonstrate cascade cells were previously demonstrated in two different 3-5 materials systems AlGaAsSb/GaAsSb and AlGaAs/GaAs. Although both of these cells were grown by liquid phase epitaxy, organo-metallic chemical vapor deposition growth techniques are also being explored. DOE

N81-25515# Midwest Research Inst., Golden Colo SOLAR ENERGY STORAGE RESEARCHERS INFORMATION USER STUDY

W W Belew Mar 1981 213 p refs

(Contract DE-AC02-77CH-00178)

(SERI/TR-751-793) Avail NTIS HC A10/MF A01

The results of a series of telephone interviews with groups of users of information on solar energy storage are described. Results from 2 groups of researchers are analyzed. DOE-funded researchers and Non-DOE-funded researchers. The data will be used as input to the determination of information products and services the Solar Energy Research Institute, the Solar Energy Information Data Bank Network, and the entire information outreach community should be preparing and disseminating. DOE

N81-25516# Midwest Research Inst., Golden Colo GENERAL SOLAR ENERGY INFORMATION USER STUDY

W W Belew, B L Wood, T L Marle and C L Reinhardt
Mar 1981 237 p refs

(Contract DE-AC02-77CH-00178)

(SERI/TR-751-753) Avail NTIS HC A11/MF A01

The results of a series of telephone interviews with groups of users of information on general solar energy are presented. These results identify types of information each group needed and the best ways to get information to each group. Results from 13 groups of respondents are analyzed: loan officers, real estate appraisers, tax assessors, insurers, lawyers, utility representatives, public interest group representatives, information and agricultural representatives, public interest group representatives, information and agricultural specialists at state cooperative extension service offices, and state energy office representatives. The data will be used as input to the determination of information products and services the Solar Energy Research Institute, the Solar Energy Information Data Bank Network, and the entire information outreach community should be preparing and disseminating. DOE

N81-25517# California Univ., Livermore Lawrence Livermore Lab

ELECTRICITY GENERATION BY SOLAR CENTRAL RECEIVERS

David W Dorn 3 Mar 1981 9 p refs

(Contract W-7405-eng-48)

(UCID-18977) Avail NTIS HC A02/MF A01

Various approaches for generating electricity are being explored that can lead to a cost effective solar central receiver plant. Experimental data were accumulated and pilot plants are now being built. The projected capital cost (1979 dollars) of a commercial solar central receiver plant with a 50% capacity factor is about \$1400/kW. The cost of electricity from such a plant is expected to be about 7.5 cents/kWh. DOE

N81-25519# Midwest Research Inst., Golden Colo PHOTOVOLTAICS SOLAR ELECTRIC POWER SYSTEMS

Feb 1980 21 p

(Contract DE-AC02-77CH-00178)

(SERI/SP-433-487) Avail NTIS HC A02/MF A01

The operation and uses of solar cells and the National Photovoltaic Program are briefly described. Eleven DOE photovoltaic application projects are described including forest lookout towers, Wilcox Memorial Hospital in Hawaii, WBNO daytime AM radio station, Schuchuli Indian Village, Meade, Nebraska, agricultural experiment, Mt. Laguna Air Force Station, public schools and colleges, residential applications, and Sea World of Florida. DOE

N81-25520# Boeing Co., Seattle Wash Solar Heating and Cooling Demonstration Program Dept

SOLAR PROJECT DESCRIPTION FOR HOMES BY MARYLYNN MULTI-FAMILY RESIDENCE, ALBUQUERQUE, NEW MEXICO

David Moore 2 Mar 1981 59 p

(Contract DE-AB01-76CS-31020)

(SOLAR/1008-80/50) Avail NTIS HC A04/MF A01

The system is designed to provide solar energy for space heating and preheating DHW. Solar energy is collected by 18 liquid flat plate collectors with a gross area of 346 square feet. Solar energy is transferred from the collector array to a 1000 gallon storage tank. Freeze protection is provided by a 50% ethylene glycol and 50% water. Solar energy is delivered to a liquid-to-air heat exchanger in the space heating subsystem in order to preheat outside air for the heat pump. Preheated city water is stored in a 30 gallon preheat storage tank and supplied, on demand, to a conventional 40 gallon DHW tank. DOE

N81-25523# Battelle Pacific Northwest Labs., Richland Wash EVALUATION OF CRITICAL MATERIALS IN FIVE ADDITIONAL ADVANCE DESIGN PHOTOVOLTAIC CELLS

S A Smith, R L Watts, P Martin, and W E Gurwell Feb 1981 133 p refs

(Contract DE-AC06-76RL-01830)

(PNL-3710) Avail NTIS HC A07/MF A01

Potential material supply constraints due to the large scale deployment of five advanced photovoltaic (PV) cell designs were identified and strategies to reduce the impacts of these production capacity limitations and potential future material are suggested. The Critical Materials Assessment Program (CMAP) screens the designs and their supply chains and identifies potential shortages which might preclude large scale use of the technologies. The results of the screening of five advanced cell designs are presented: (1) indium phosphide/cadmium sulfide, (2) zinc phosphide, (3) cadmium telluride/cadmium sulfide, (4) copper indium selenide, and (5) cadmium selenide photoelectrochemical. Each of these five cells is screened individually. The CMAP methodology used to identify critical materials, is described. Detailed characterizations of the advanced photovoltaic cell designs, descriptions of additional cell production processes and the results are presented. DOE

N81-25525# Acurex Corp., Mountain View, Calif Alternate Energy Div

SOLAR PRODUCTION OF INDUSTRIAL PROCESS STEAM, PHASE 3 OPERATION AND EVALUATION OF THE JOHNSON AND JOHNSON SOLAR FACILITY Final Report, 1 Jan 1980 - 31 Mar 1981

D F Brink, J M Kendall, and S B Youngblood Mar 1981 115 p refs

(Contract DE-AC03-77CS-31713)

(DOE/CS-31713/T1) Avail NTIS HC A06/MF A01

The facility consists of 1068 sq m of parabolic trough concentrating collectors, a 18,900 flash boiler and an 18.6 kW circulating pump. In the first year of operation the system was available 97 percent of the days, and with sufficient solar radiation available it operated 70 percent of the days during this period. The measured data showed that the collector field operated at an efficiency of 25.4 percent for the year and that at least 75 percent of the energy reaching the flash boiler was delivered to the plant as steam. A total of 309,510 kg of steam was produced by the solar facility for the first year. An analysis of the data showed that the delivered energy was within 90 to 100 percent of the predicted value. DOE

N81-25526# Argonne National Lab., Ill Components Technology Div

COMMIX-SA-1 A THREE-DIMENSIONAL THERMOHYDRODYNAMIC COMPUTER PROGRAM FOR SOLAR APPLICATIONS

W T Sha, E I H Lin, R C Schmitt, K V Liu, J R Hull, J J Oras, Jr and H M Domanus Nov 1980 49 p refs

(Contract W-31-109-eng-38)

(ANL-80-8) Avail NTIS HC A03/MF A01

The COMMIX-SA-1 is a three dimensional transient single phase compressible flow component computer program was developed. Its utilization for solar applications in general and for analysis of thermocline storage tanks in particular. The conservation equations for mass, momentum, and energy are

solved as an initial boundary value problem. The numerical solution procedure, based on a modified ICE (Implicit Continuous-Fluid Eulerian) technique and method for treating the singularity problem arising at the origin of a cylindrical coordinate system are described. The thermal interactions between fluid and structures (tank walls, baffles, etc.) are accounted for. The COMIX-SA-1 code structure is delineated and an input description and sample problems are presented. DOE

N81-25527# Cornell Univ. Ithaca, N. Y. Lab. of Atomic and Solid State Physics.

DESIGN OF SELECTIVE SURFACES FOR SOLAR ENERGY COLLECTION

D. M. Trotter, Jr., H. G. Craighead, and A. J. Sievers. 1981. 13 p. refs.

(Contracts DE-AS03-77ET-20413, EG-77-S-03-1456, Grant NSF DMR-76-81083)

(DOE/ET-20413/T1) Avail. NTIS HC A02/MF A01

Numerical calculations done to determine the total hemispherical solar absorptivity and the total hemispherical emissivity in the infrared of selective surfaces composed of a dielectric film on a metal substrate are discussed. The selectivity of the surface as a function of the refractive index of the film is discussed as well as the effect of grading the index of the film. It is concluded that the most effective film is one having $n \ll L$ as close to unity as possible through its entire thickness while $k \ll L$ increases from zero at the front surface to a larger value at the back surface. DOE

N81-25529# University of Southern California, Los Angeles. Lab. of Biomedical and Environmental Sciences.

COMMUNITY APPLICATIONS OF SMALL-SCALE SOLAR THERMAL ENERGY SYSTEMS

John H. Baldwin, Carl Steinberg, and David Stea. Feb. 1981. 177 p. refs.

(Contract DE-AC03-76SF-00012)

(UCLA-12/1279) Avail. NTIS HC A09/MF A01

Rapid technological development of small scale solar thermal energy systems (STES) may bring them on line before communities are adequately prepared for them. Information for analyzing and siting STES is presented along with discussions of community applications, regulations, impacts and incentives. By providing this information to community planners it is hoped that barriers to STES utilization can be anticipated and mitigated. DOE

N81-25533# Westinghouse Research and Development Center, Pittsburgh, Pa.

DEVELOPMENT OF COPPER SULFIDE/CADMIUM SULFIDE THIN-FILM SOLAR CELLS Technical Progress Report, 13 Apr - 12 Jul 1980

J. R. Szodon, W. J. Biter, J. A. Abel, H. C. Dickey, and F. A. Shirland. 27 Feb. 1981. 73 p. refs.

(Contract DE-AC02-77CH-00178)

(SERI/PR-8143-1-T3, TPR-4) Avail. NTIS HC A04/MF A01

Aspects of cell fabrication and treatment which are critical for achieving high efficiency Cu₂S/CdS solar cells were identified. Several comparisons were made of the effects of specific steps in two methods of cell fabrication. Three areas requiring special attention and specific means to achieve acceptable results were identified: (1) the Cu₂S/CdS heterojunction area must be minimized; (2) termination of the wet barrier processing steps must be done carefully; (3) the Cu₂S layer should not be exposed to high temperatures for long periods of time if surface absorbed moisture or oxygen are present. If precautions are taken, wet chemical barrier processing of thermally evaporated CdS films on zinc plated copper foil substrates yields cells of nearly 8% conversion efficiency without AR coating. DOE

N81-25534# United Technologies Research Center, East Hartford, Conn.

DESIGN, DEVELOPMENT AND TESTING OF A SOLAR-POWERED MULTI-FAMILY RESIDENTIAL SIZE PROTOTYPE TURBOCOMPRESSOR HEAT PUMP Interim Technical Report

Mar. 1981. 314 p. refs. Prepared in cooperation with Hamilton Standard, Windsor Locks, Conn.

(Contract DE-AC03-77CS-34510)

(DOE/CS-34510/T1, UTRC/R79-953050-1) Avail. NTIS HC A14/MF A01

A solar system designed to use the turbocompressor heat pump module including all of the subsystems required and the

various system operating modes is described. The preliminary design analyses conducted to select the heat pump module components and operating features, working fluid configuration, size and performance goals and estimated performance levels in the cooling and heating modes are included. A detailed description of the other subsystems and components required for a complete solar installation is provided. Using realistic performance and cost characteristics for all subsystems, the seasonal performance of the UTC heat pump is described in various US locations. In addition, the estimated energy savings and an assessment of the economic viability of the solar system is presented. DOE

N81-25535# Sandia Labs., Albuquerque, N. Mex. Experimental Systems Operations Div.

MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY PREDICTIONS FOR THERMAL PERFORMANCE BASED ON TEST DATA CUSTOM ENGINEERING TROUGH WITH GLASS REFLECTOR SURFACE AND SANDIA-DESIGNED RECEIVERS

Thomas D. Harrison. May 1981. 25 p. ref.

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/10) Avail. NTIS HC A02/MF A01

Thermal performance predictions based on test data are presented for the trough and receivers for three output temperatures at five cities in the United States. Two experimental receivers were tested, one with an antireflective coating on the glass envelope around the receiver tube, and one without the antireflective coating. DOE

N81-25539# Spire Corp., Bedford, Mass.

SILICON CONCENTRATOR SOLAR CELL DEVELOPMENT

Mar. 1981. 84 p. refs.

(Contract DE-AC04-76DP-00789)

(SAND-81-7005) Avail. NTIS HC A05/MF A01

Discussions include the development of the device design, the development of the manufacturing process sequence, and the accompanying cost analyses. Several concentrator cell designs were developed that are compatible with cell assemblies using conventional and electrostatically bonded coverglasses. The cell geometries are suitable for 20 to 50 sun line or point focus concentrator optical systems with illuminated areas that are 5 cm wide. The process sequence required to manufacture the cell is based on ion implantation and pulse annealing for junction and back surface field formation. DOE

N81-25541*# IBM Federal Systems Div., Huntsville, Ala.

SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FOR SOLARON AKRON, AKRON, OHIO Final Report

Sep. 1980. 106 p. refs. Prepared for DOE.

(Contract NAS8-32036)

(NASA-CR-161729) Avail. NTIS HC A06/MF A01 CSCL 10A

The economic analysis of the solar energy system that was installed at Akron, Ohio is developed for this and four other sites typical of a wide range of environmental and economic conditions. The analysis is accomplished based on the technical and economic models in the f chart design procedure with inputs based on the characteristics of the installed parameters of present worth of system cost over a projected twenty year life, life cycle savings, year of positive savings and year of payback for the optimized solar energy system at each of the analysis sites. The sensitivity of the economic evaluation to uncertainties in constituent system and economic variables is also investigated. Results show that only in Albuquerque, New Mexico where insolation is 1828 Btu/sq ft/day and the conventional energy cost is high, is this solar energy system marginally profitable. MG

N81-25542*# IBM Federal Systems Div., Huntsville, Ala.

SOLAR ENERGY SYSTEM ECONOMIC EVALUATION FOR IBM SYSTEM 18, CARLSBAD, NEW MEXICO Final Report

Sep. 1980. 99 p. refs. Prepared for DOE.

(Contract NAS8-32036)

(NASA-CR-161730) Avail. NTIS HC A05/MF A01 CSCL 10A

The economic performance of an operational test site of a solar energy system is described. The viability of the system

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was tested over a broad range of environmental and economic conditions. Significant results are reported. RCT

N81-25546# Mueller Associates Inc Baltimore Md **ECONOMIC ANALYSIS OF RESIDENTIAL COMBINED SOLAR-HEATING AND HOT-WATER SYSTEMS**

23 Sep 1980 79 p refs
(Contract W-31-109-eng-38)

(ANL-K-80-63 MAI-202) Avail NTIS HC A05/MF A01

The monthly costs and savings of the typical system are discussed. The economic evaluation of solar residential systems is presented in increasing levels of complexity. Utilizing a typical system, the effective interest rate that the purchaser of a system would receive on money invested is shown for all regions of the country. The importance of numerous variables that can make a significant difference on the economics of the system is described so that it can be determined whether the typical system economics are compatible with the particular situation. Methods for calculating the payback period for any non-typical solar system are described. This calculated payback period is then shown to be related to the effective interest rate that the purchaser of the system would receive for a typical economic condition. DOE

N81-25547# Living Systems Winters, Calif **THE SUNCATCHER AND COOL POOL**

Jonathan Hammond 1 Mar 1981 104 p
(Contracts EG-77-G-04-4153 DE-FG04-77CS-34153)
(DOE/CS-34153/4) Avail NTIS HC A06/MF A01

A simple, conical solar concentrating device that captures light entering clerestory windows and directs it onto thermal storage elements at the back of a south facing living space was designed to capture low angle winter sunlight and to reflect away higher angle summer sunlight. It is found that winter radiation through a Suncatcher window is 40 to 50 percent higher than through an ordinary window, and that the average solar fraction is 59 percent. Five Suncatcher buildings are described. An evaporating, shaded roof pond thermosiphons cool water into water filled columns within a building. Preliminary experiments indicate that the best shade design has unimpeded north sky view, good ventilation, complete summer shading, a low architectural profile, and low cost attic vent lowers work. Although an unshaded pool cools better at night than a shaded one, daytime heat gain far offsets this advantage. DOE

N81-25548# Mueller Associates, Inc Baltimore Md **ECONOMIC ANALYSIS OF RESIDENTIAL AND COMMERCIAL SOLAR HEATING AND HOT WATER SYSTEMS**

23 Sep 1980 90 p refs

(Contract W-31-109-eng-38)

(ANL-K-80-59, MAI-206) Avail NTIS HC A05/MF A01

Two distinct methods of analysis were used to evaluate both taxable and nontaxable applications of solar heating and hot water systems in residential and commercial buildings. The case flow analyses provide insight into the short and long term effects of a solar investment on the budget of the solar energy system purchaser while the return on investment analyses provide an appropriate method of measuring the attractiveness of a solar investment in comparison to alternative long term investments. The sensitivity of the results on the numerous variables in the economic analyses is shown. Maps provide a graphic display of the results of the economic analysis of typical systems using Federal and state tax credits and average state conventional fuel costs for each system type. Conclusions based on the economic analyses performed and a discussion of the present status of the data required for the complete economic evaluation of solar energy systems are summarized. DOE

N81-25549# Northrup Inc Hutchins, Tex **SECOND GENERATION HELIOSTAT DEVELOPMENT FOR SOLAR CENTRAL RECEIVER SYSTEMS DETAILED DESIGN REPORT VOLUME 2 APPENDICES**

May 1980 315 p Prepared in cooperation with Bechtel National, Inc San Francisco and Booz-Allen and Hamilton New York
(Contract DE-AC04-76DP-00789)

(SAND-79-8194-Vol-2-App) Avail NTIS HC A14/MF A01

Drawings and other data pertinent to the design, manufacture, installation and control of a second generation heliostat are presented. These include (1) a bill of materials (2) subassembly drawings (3) heliostat assembly drawings, (4) trade studies, (5) system studies, (6) control software (7) test results (8) specification S-102 surface preparation, application and inspection of protective coatings for carbon steel heliostat piles,

and (9) specification S-101 installation of open end pipe piles. For additional information on the heliostat design, manufacture, installation, maintenance and cost estimates see STAR document N81-22553. A R H

N81-25553# Purdue Univ, Lafayette Ind Dept of Chemistry

FLASH PHOTOELECTROCHEMICAL STUDIES OF TRANSIENT ELECTRODE PROCESSES IMPORTANT IN SOLAR ENERGY CONVERSION Progress Report, 1 May 1980 - 30 Apr. 1981

Sam P Perone Dec 1980 22 p refs

(Contract DE-AS02-77ER-04263)

(DOE/ER-04263/4) Avail NTIS HC A02/MF A01

The program objectives related to pulsed laser irradiation of semiconductor/liquid junction photoelectrochemical cells were to detect and characterize transient photoproducts due to electrode and/or solution photoelectrolysis at the interface, obtain time resolved photoelectrolysis data indicative of charge transfer rates, obtain photoelectrochemical measurements related to electron hole recombination rates subsequent to pulsed laser irradiation, and utilize complementary spectroscopic methods for characterizing transient photoprocesses at the semiconductor/electrolyte interface. The dynamics of supsensitizer interactions with sensitizing dyes adsorbed at the interface were characterized. DOE

N81-25557# Naval Weapons Center, China Lake, Calif **PREPARATION AND CHARACTERIZATION OF HYDROGENATED AMORPHOUS SILICON** Quarterly Progress Report, 1 Sep. - 30 Nov. 1980

T M Donovan 1980 11 p

(Contract DE-AC02-77CH-00178)

(SERI/PR-8142-4-T1, QPR-6) Avail: NTIS HC A02/MF A01

Direct current magnetron sputtering was evaluated as a viable approach to producing amorphous SiH thin films for solar photovoltaic applications. It is shown that the optical and transport properties of these films are similar to those of rf diode sputtered material, but the photoresponse and, more importantly, Schottky diode performance are inferior to that already obtained by rf diode sputtering. In order to improve film morphology, ion bombardment was added to the deposition process. Transmission electron microscopy and SIMS measurements are discussed. Optical properties, transport, and photoconductivity of oxygen doped rf diode films are discussed. DOE

N81-25560# Midwest Research Inst, Golden Colo **COMPARISON OF DOE-2 AND TRANSYS SOLAR HEATING SYSTEM SIMULATION**

Anthony Eden and Marion Morgan Dec 1980 73 p refs

(Contracts EG-77-C-01-0402, DE-AC02-77CH-00178)

(SERI/TR-721-822) Avail NTIS HC A04/MF A01

The analysis of the output of the solar energy section called Component Based Simulation (CBS) is discussed. The adequacy and sensitivity of CBS when various active solar energy collectors and systems were interfaced with a standard space heating system were investigated. The analysis included both single and double glazed collectors with selectively and nonselectively coated absorbing surfaces located in four different environments. The results show the agreement between the two programs to be remarkably similar. Graphs are presented to illustrate the minor differences in annual average collector efficiency and annual average part solar as well as the thermal load and insolation levels. DOE

N81-25561*# Argonne National Lab, Ill **SURVEY AND DOCUMENTATION OF EMERGING TECHNOLOGIES FOR THE SATELLITE POWER SYSTEM (SPS)**

Peter Glaser and Phillip Chapman (Little Arthur D., Inc) Apr 1981 133 p refs Sponsored in part by NASA

(Contract W-31-109-eng-38)

(NASA-CR-164418 DOE/ER-0097)

Avail NTIS

HC A07/MF A01 CSCL 01A

The genesis of the solar power satellite (SPS) concept is reviewed historically and the original assumptions and guidelines which led to development of the SPS reference system design concept are discussed. Some guidelines are applicable to almost any SPS design, but others can be changed leading to new and perhaps preferable systems. In order to stimulate new SPS concepts and to facilitate comparative assessment of emerging SPS technologies one useful approach is to break the overall

system into functional parts. The system functions which must be performed by any SPS concept and the interrelations between them are discussed and a systematic framework is presented for assessing the wide variety of system concepts and subsystem technologies which have been proposed. About 80 alternative SPS technologies are reviewed. DOE

N81-25562# Automation Industries, Inc. Silver Spring Md
**SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION-
LIVING SYSTEMS, DAVIS, CALIFORNIA, OCTOBER 1979 -
FEBRUARY 1980**

J W Spears 1980 78 p refs
(Contract DE-AC01-79CS-30027)

(SOLAR/1046-80/14) Avail NTIS HC A05/MF A01

The solar energy system is designed to supply 88% of the space heating. It is equipped with 273 sq ft of south-facing double glazing for passive direct gain, 3343 gallons of water storage in site-built containers and six-inch concrete slab, and a 35,000 Btu gas furnace and a 30,000 Btu wood stove for auxiliary heating. The systems actually provided 80% of the space heat. DOE

N81-25563# Automation Industries, Inc., Silver Spring Md
**SOLAR ENERGY SYSTEM PERFORMANCE EVALUATION
M F SMITH, JAMESTOWN, RHODE ISLAND, OCTOBER
1979 - APRIL 1980**

E N Ashman 1980 92 p
(Contract DE-AC01-79CS-30027)

(SOLAR/1056-80/14-Rev) Avail NTIS HC A05/MF A01

The active solar energy system is designed to supply 78% of the space heating requirements and 51% of the hot water. The gross collector array is 512 sq ft. The cover of the collector is made of a double glazing, light weight durable translucent fiberglass material, bonded to support aluminum I beam guide core. Water is the transfer medium of the collector. Heat from the collector is stored in a standing 3150 gallon concrete tank located in the basement of the house. Heat is distributed to the living area by a water to air heat pump with a heating capacity of 33 000 Btu/hr. The heat pump draws heat from the water and heats air which is blown throughout the house by means of a duct system. The systems actually produced 78% of the space heating requirements and 73% of the hot water. DOE

N81-25565# Rockwell International Corp., Anaheim, Calif
Microelectronics Research and Development Center
**CHEMICAL VAPOR DEPOSITION OF THIN-FILM POLY-
CRYSTALLINE SI FOR LOW-COST SOLAR CELLS** Final
Technical Report, 23 Jul. 1979 - 22 Jul 1980

Ralph P Ruth, William I Simpson, Jane J J Yang, Lavada A Moudy, Harold M Manasevit and Richard E Johnson Sep 1980 189 p refs
(Contract DE-AC03-79ET-23045)

(DOE/SF-23045/4, Rept-80-738/501) Avail NTIS HC A09/MF A01

A one year research program was carried out for the purpose of developing thin film polycrystalline Si solar cells on low cost substrate materials directed toward the goal of achieving photovoltaic conversion efficiencies greater than 10 percent (AM1) at a cost of \$100 to \$300/kW (electric). The polycrystalline Si films used for the cells were prepared by direct chemical vapor deposition (CVD) techniques, and the required junctions/barriers were formed both by doping during film growth and by subsequent thermal diffusion. DOE

N81-25566# Westinghouse Research and Development Center,
Pittsburgh, Pa

**EMERGING MATERIAL SYSTEMS FOR SOLAR-CELL
APPLICATIONS** Technical Progress Report, 17 Oct. 1979 -
16 Jan 1980

W J, Biter and J R Szadon 23 Jul 1980 20 p refs
(Contract DE-AC02-79ET-23003)

(DOE/ET-23003/3 TPR-3) Avail NTIS HC A02/MF A01

The plasma deposition system was completed and a number of deposition of InP were made with the indium transported into the reaction zone via the vapor phase transport of indium chloride. Amorphous films of InP were obtained when the substrate was at room temperature. Substrate temperatures above approximately 200 C resulted in polycrystalline films. Junctions were formed in n type InP by diffusion of Cd using a sealed tube technique. DOE

N81-25569# State Univ of New York at Buffalo Dept of
Electrical Engineering

**MIS SOLAR CELLS ON THIN POLYCRYSTALLINE SILICON
Progress Report, 1 Sep - 30 Nov 1980**

W A Anderson Dec 1980 84 p refs

(Contract DE-AC02-77CH-00178)

(SERI/PR-9080-1-T3, PR-3) Avail NTIS HC A05/MF A01

The first task of this project involves electron-beam deposition of thin silicon films on low cost substrates. The goal is to obtain 20 (SIGMA)m thick films having 20 (SIGMA)m diameter crystallites which may be recrystallized to > 40 (SIGMA)m. Material characterization and device studies are to be included in efforts to reach a 6% conversion efficiency. The second task deals with MIS solar cell fabrication on various types of silicon including poly-Si, ribbon-Si silicon on ceramic and thin film silicon. Conduction mechanism studies optimum engineering design, and modification of the fabrication process are to be used to achieve 13% efficiency on Xtal-Si and 11% efficiency on poly-Si. The third task involves more detailed test procedures and includes spectral response interface and grain boundary effects computer analysis materials studies, and grain boundary passivation. DOE

N81-25590# Automation Industries, Inc. Silver Spring Md
**MARCH 1981 ENVIRONMENTAL DATA FOR SITES IN THE
NATIONAL SOLAR DATA NETWORK**

D M Roha Mar 1981 222 p refs

(Contract DE-AC01-79CS-30027)

(SOLAR/0010-81/03) Avail NTIS HC A10/MF A01

The data include insolation temperatures, wind speed and direction and humidity for each day. Insolation data include total, diffuse, direct maximum and extraterrestrial insolation. Temperature data include average daytime, nighttime, maximum and minimum temperatures, and system cold water inlet temperatures for sites with domestic hot water systems. Humidity data include day and night values and maximum and minimum values. Most data are taken every 5 min. Rapidly varying data are taken every 32 sec. A technical discussion of the instruments and measurements used is included. DOE

N81-26173*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio

**DETERMINATION OF OPTIMUM SUNLIGHT CONCENTRA-
TION LEVEL IN SPACE FOR GALLIUM ARSENIDE SOLAR
CELLS**

Henry B Curtis 1981 8 p refs Presented at the 15th Photovoltaic Spec Conf Kissimmee Fla 12-15 May 1981 sponsored by the Inst of Electrical and Electronics Engineers (NASA-TM-82643 E-898) Avail NTIS HC A02/MF A01 CSCL 10A

The solar cell diode equation was used to calculate the optimum values or range of values of concentration ratios. A variety of temperature vs concentration assumptions were used and cell area and series resistance were varied. The coefficients of the diffusion and recombination terms vary strongly with temperature while the light generated current is a weak function of temperature and proportional to concentration. The study indicates that the cell temperature vs concentration ratio assumption is critical. It appears that concentration levels of approximately 100X are feasible in space. TM

N81-26297# Colorado Div of Highways Denver

SOLAR POWERED HIGHWAY SIGN Final Report

Robert L Hayden and Werner Hutter Sep 1980 59 p refs Sponsored in part by Federal Highway Administration, Washington Prepared by Colorado Div of Highways

(PB81-160004 CDOH-DTP-R-80-9 FHWA/CO/RD-80/9) Avail NTIS HC A04/MF A01 CSCL 13B

A roadside sign was equipped with lights powered by photovoltaic solar panels to improve nighttime visibility and evaluate equipment performance and needs. The photovoltaic panels were found to be reliable and effective for powering flashing lights on a highway warning sign. Cost of the panels is high so their use should be limited to locations where commercial electrical power is not available. Solar electric systems should be carefully designed to minimize costs and produce a reliable system. Sufficient prediction for the solar panels should be provided in areas where theft or vandalism might be a problem. GRA

N81-26552*# National Aeronautics and Space Administration
Pasadena Office, Calif

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SCHOTTKY BARRIER CELL AND METHOD OF FABRICATING IT Patent Application

Richard J. Stirn (JPL California Inst of Technology Pasadena) and Yea-chuan M. Yeh, inventors (to NASA) (JPL, California Inst of Technology, Pasadena) Filed 16 Jan 1981 33 p Sponsored by NASA

(NASA-Case-NPO-13689-3, US-Patent-Appl-SN-225494) Avail NTIS HC A03/MF A01 CSCL 10A

The cell consists of a barrier formed by a polycrystalline active semiconductor layer of GaAs and a thin metal layer. The active semiconductor layer is grown on a polycrystalline semiconductor layer of germanium, serving as a substrate. The latter is first deposited with submicron crystal sizes and thereafter recrystallized so as to increase the crystal sizes to not less than 5-10 microns in size. This process eliminates the need for an expensive single crystal wafer. T M

N81-26553* National Aeronautics and Space Administration Pasadena Office Calif

SCHOTTKY BARRIER CELL AND METHOD OF FABRICATING IT Patent Application

Richard J. Stirn (JPL, California Inst of Technology, Pasadena) and Yea-chuan M. Yeh, inventors (to NASA) (JPL, California Inst of Technology, Pasadena) Filed 16 Jan 1981 33 p Sponsored by NASA

(NASA-Case-NPO-13689-4, US-Patent-Appl-SN-225501) Avail NTIS HC A03/MF A01 CSCL 10A

The cell consists of a barrier formed by a polycrystalline active semiconductor layer of GaAs and a thin metal layer. The active semiconductor layer is grown on a polycrystalline semiconductor layer of germanium, serving as a substrate. The latter is first deposited with submicron crystal sizes and thereafter recrystallized so as to increase the crystal sizes to not less than 5-10 microns in size. The process eliminates the need for an expensive single crystal wafer. T M

N81-26554* AeroChem Research Labs, Inc. Princeton, N J DEVELOPMENT OF PROCESSES FOR THE PRODUCTION OF SOLAR GRADE SILICON FROM HALIDES AND ALKALI METALS, PHASE 1 AND PHASE 2 Final Report, Oct. 1979 - Feb 1981

C. R. Dickson, R. K. Gould, and W. Felder Mar 1981 66 p refs Sponsored in part by DOE Prepared for JPL (Contract JPL-955491)

(NASA-CR-164480 DOE/JPL-955491-81/6 JPL-9950-552, AeroChem-TP-410) Avail NTIS HC A04/MF A01 CSCL 10A

High temperature reactions of silicon halides with alkali metals for the production of solar grade silicon are described. Product separation and collection processes were evaluated. Measure heat release parameters for scaling purposes and effects of reactants and/or products on materials of reactor construction were determined, and preliminary engineering and economic analysis of a scaled up process were made. The feasibility of the basic process to make and collect silicon was demonstrated. The jet impaction/separation process was demonstrated to be a purification process. The rate at which gas phase species from silicon particle precursors, the time required for silane decomposition to produce particles and the competing rate of growth of silicon seed particles injected into a decomposing silane environment were determined. The extent of silane decomposition as a function of residence time, temperature, and pressure was measured by infrared absorption spectroscopy. A simplistic model is presented to explain the growth of silicon in a decomposing silane environment. E A K

N81-26555* Applied Concepts Corp. Reston, Va USAF SOLAR THERMAL APPLICATIONS OVERVIEW Final Report

J. Scott Hauger and James A. Simpson 4 May 1981 60 p (Contract JPL-955887) (NASA-CR-164481, JPL-9950-546, TR-03-81) Avail NTIS HC A04/MF A01 CSCL 10A

Process heat applications were compared to solar thermal technologies. The generic process heat applications were analyzed for solar thermal technology utilization, using SERI's PROSYS/ECONOMAT model in an end use matching analysis and a separate analysis was made for solar ponds. Solar technologies appear attractive in a large number of applications. Low temperature applications at sites with high insolation and high fuel costs were found to be most attractive. No one solar thermal technology

emerges as a clearly universal or preferred technology, however, solar ponds offer a potential high payoff in a few, selected applications. It was shown that troughs and flat plate systems are cost effective in a large number of applications. E A K

N81-26557* Ducat Investments, Inc., Kansas City, Kans SOLAR SPACE HEATING INSTALLED AT KANSAS CITY, KANSAS Final Report

May 1981 135 p refs (Contract EG-77-A-01-4079)

(NASA-CR-161763) Avail NTIS HC A07/MF A01 CSCL 10A

The solar energy system was constructed with the 48,800 square feet warehouse to heat the warehouse area of about 39,000 square feet while an auxiliary energy system heats the office area of about 9,800 square feet. The building is divided into 20 equal units, and each has its own solar system. The modular design permits the flexibility of combining multiple units to form offices or warehouses of various size floor areas as required by a tenant. Each unit has 20 collectors which are mounted in a single row. The collectors are double glazed flat plate collectors with a gross area of 7,800 sq ft. Air is heated either through the collectors or by the electric resistance duct coils. Extracts from the site files, specifications, drawings, installation operation and maintenance instructions are presented. T M

N81-26558* Energietechnik GmbH, Essen (West Germany) Studiengesellschaft fuer Energie-Umwandlung, -Fortleitung und -Anwendung

LONG-TERM ENERGY STORAGE TANKS FOR DWELLINGS AND SOLAR HOUSE ARCHITECTURE Final Report

Bonn Bundesministerium fuer Forschung und Technologie Dec 1980 93 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie Prepared in cooperation with Baehr u. Gansfort, Architekten (BMFT-FB-T-80-173-Pt-A/B, ISSN-0340-7608) Avail NTIS HC A05/MF A01

The design and installation of hot water storage tanks as accumulators of solar energy is presented. Solar house architecture which maximizes roof, solar collector energy absorption potential is then considered. Proposals for residential areas which include solar houses are made.

N81-26560* Energietechnik GmbH, Essen (West Germany) Studiengesellschaft fuer Energie-Umwandlung, -Fortleitung und -Anwendung

LONG-TERM ENERGY STORAGE TANKS, PART A Final Report

Bernd Dietrich In its Long-Term Energy Storage Tanks for Dwelling and Solar House Arch Dec 1980 p 5-33 refs In GERMAN

Avail NTIS HC A05/MF A01

Low cost storage of solar energy in decentralized large hot water accumulation tanks for dwellings was studied. Integration of the tank into a practical economical solar energy collector system was carried out. The experience gained with the construction and operation of several test tanks was used to design a large volume, cubic, compact hot water tank whose prefabricated individual parts are easily transported into a cellar and assembled without difficulty. Examples of installations are shown. The optimization scheme for the solar collector/hot water accumulation interface is also presented. Solar energy conversion investigations show a considerable improvement in prolonged system effectiveness, particularly when collectors with lower efficiencies are used. Author (ESA)

N81-26563* Virginia Polytechnic Inst and State Univ., Blacksburg

CdSiAs₂ THIN FILMS SOLAR CELL APPLICATIONS Quarterly Report, 1 Oct - 31 Dec 1979

L. C. Burton and L. H. Slack Feb 1980 17 p refs

(Contract DE-AC02-79ET-23007)

(DOE/ET-23007/3) Avail NTIS HC A02/MF A01

Sputtering studies of CdSiAs₂ films continued. An improved substrate was developed (Ta film on 7059 glass) for post-deposition heat treatments, although films still have mechanical defects. CdS/CdSiAs₂ and In/CdSiAs₂ junctions were formed on heat treated CdSiAs₂ films. Both junction types exhibit

rectifying behavior, although with little photovoltaic response. Poor yield and unstable characteristics are attributed to mechanical defects in the CdSiAs₂ films. The new multitarget sputtering unit is now installed and operating. DOE

N81-26564# Delaware Univ., Newark Inst of Energy Conversion

Zn₃P₂ AS AN IMPROVED SEMICONDUCTOR FOR PHOTOVOLTAIC SOLAR CELLS Quarterly Report, 1 Sep. - 31 Nov 1980

M Brushman, A Catalano, and P S Nayar 1980 57 p refs (Contract DE-AC02-76CH-00178)

(SERI/PR-9062-1-T5, QR-8) Avail NTIS HC A04/MF A01

Frequency and voltage dependent capacitance measurements of ZnO/Zn₃P₂ heterojunctions were made and the results interpreted according to a model which considers the total capacitance arising from contributions due to the depletion layer capacitance, interface charges and a dipole charge. The capacitance of the devices is anomalously high at low frequencies but agrees well with the value calculated from the bulk carrier density at 1 MHz. The data suggest a significant contribution to the capacitance from the charging and discharging of interface states. Direct evidence for a relationship between defects in the Zn₃P₂ (grains boundaries, dislocations, etc.), and the collected current were found by comparing EBIC images of ZnO/Zn₃P₂ devices with the etched surfaces of the samples. DOE

N81-26565# Research Triangle Inst., Research Triangle Park, N C

DEVELOPMENT OF HIGH-EFFICIENCY, LOW-COST ZnSiAs₂ SOLAR CELLS Final Report, 9 Apr 1979 - 9 Jun. 1980

J E Andrews 1980 42 p refs

(Contract DE-AC04-79ET-23001)

(DOE/ET-23001/T6) Avail NTIS HC A03/MF A01

The development of a ZnSiAs₂/Si-web cascade solar cell is described. Calculations indicate, given a suitable material quality, that 23% efficiencies may be possible and that the Si-web substrate and materials proposed for this cell offer the potential for meeting the cost goals. Significant results include the successful conversion of the original open tube vapor phase epitaxial growth system to an organometallic growth approach which in turn led to reduced carrier concentrations, and improved material quality. Additionally epitaxial growth was obtained on alpha-Al₂O₃ and Si substrates. ZnSiAs₂/Si structures were fabricated in which carrier collection from both sides of the interface was observed using the electron beam induced current measurement technique. N-type impurity doping experiments were initiated with the objective of synthesizing n-ZnSiAs₂ via substitutional doping. DOE

N81-26569# Pease (J M) Associates, Charlotte, N C

PASSIVE SOLAR COMMERCIAL BUILDINGS- DESIGN ASSISTANCE AND DEMONSTRATION PROGRAM, MOUNT AIRY PUBLIC LIBRARY, PHASE 1 Final Report

26 Jan 1981 284 p Prepared jointly with Mazria (Edward) and Associates

(Contract DE-FC02-80CS-30329)

(DOE/CS-30329/T1) Avail NTIS HC A13/MF A01

The final design of the library is given. Incremental passive design costs are discussed. Performance and economic analyses are made and the results reported. The design process is thoroughly documented. Considerations discussed are building energy needs, site energy potentials matching energy needs with site energy potentials, design indicators for best strategies and concepts, schematic design alternatives performance testing of the alternatives, design selection, and design development. Weather data and Duke Power electric rates are included. DOE

N81-26571# Wisconsin Energy Extension Service, Madison

MAKING OF A SOLAR VILLAGE A CASE STUDY OF A SOLAR DOWNTOWN DEVELOPMENT PROJECT AT SOLDIER GROVE, WISCONSIN

William S Becker 1980 52 p refs

(Contract W-31-109-eng-38)

(DOE/TIC-11420) Avail NTIS HC A04/MF A01

A master plan for the development of the village is presented. The planning procedures are described and include the choosing of building designs, the involvement of the citizens, and the analysis of legal problems. A view of other communities trying similar techniques is presented. T M

N81-26572# Johnson (Alfred L.), Manhattan Beach, Calif

SOLAR POWERED CIRCULATION PUMP DEVELOPMENT Final Report

Alfred L Johnson Sep 1980 64 p refs

(Contract DE-FG03-78SF-02005)

(DOE/SF-02005/T1) Avail NTIS HC A04/MF A01

The state-of-the-art of liquid piston heat engines was examined. Next a morphological analysis of the original concept was performed. An analysis of the pump performance from a theoretical basis was performed by deriving and solving the equations governing the cycle. The results are documented. An experimental evaluation of the condensing phenomena was performed. It was assumed that the boiling could be conducted in the solar panel. A number of solar panel designs were examined and the most appropriate type of solar panel is described. A 1/4th scale unit was fabricated and tested. The overall efficiency was approximately 1% at the design point, compared with a theoretical limit of 1.6% for the given operating conditions. The production costs of the full size pump were examined. Systems integration aspects were considered and the results are presented. DOE

N81-26575# Los Alamos Scientific Lab N Mex

SOLAR LOAD RATIO METHOD APPLIED TO COMMERCIAL BUILDING ACTIVE SOLAR SYSTEM SIZING

Norman M Schnurr, Bruce D Hunn, and Kenneth D Williamson, III 1981 31 p refs Presented at the 3rd Ann Systems Simulation, Econ Analysis/Solar Heating and Cooling Operation Results Conf, Reno, Nev 27 Apr - 1 May 1981

(Contract W-7405-eng-36)

(LA-UR-80-3040 CONF-810405-1) Avail NTIS

HC A03/MF A01

The DOE-2 building energy analysis computer program is described. It is capable of calculating the loads and of simulating various control strategies in detail for both residential and commercial buildings and yet is computationally efficient enough to be used for extensive parametric studies. In addition to a Building Service Hot Water System and a combined space heating and hot water system using liquid collectors for a commercial building analyzed previously, a space heating system using an air collector is analyzed. A series of runs is made for systems using evacuated tube collectors for comparison to flat-plate collectors, and the effects of additional system design parameters are investigated. Also, the generic collector types are characterized by standard efficiency curves, rather than by detailed collector specifications. DOE

N81-26580# Messerschmitt-Boelkow-Blohm G m b H, Munich (West Germany) Space Division

TECHNOLOGICAL ACTIVITIES FOR HIGH PERFORMANCE RECEIVERS Final Report

Gunther Schmidt, Erich Kirner, and Helmut Zewen Dec 1980 86 p refs In GERMAN ENGLISH summary

(BMFT-FB-T-80-133 UR-39979-79 ISSN-0340-7608) Avail NTIS (US Sales only) HC A04/MF A01 DOE Depository Libraries

For solar thermal power plants the energy transfer efficiency from the incident solar radiation into the heat transfer medium has a direct impact on the overall plant efficiency and influences the size of the cost effective collector field. For this reason technological activities were accomplished for high performance receivers to be operated in closed Rankine cycles with organic heat transfer media at temperatures between 350 C to 400 C and gas turbine cycles at temperatures between 800 C to 900 C. Under simulated test conditions the thermal and mechanical resistance of the structure and the behavior of different heat transfer media with respect to thermal efficiency and stability were analyzed. DOE

N81-26983# California Univ., Livermore Lawrence Livermore Lab

ROLE OF FINANCING IN THE MARKETABILITY OF CAPITAL INTENSIVE SOLAR TECHNOLOGIES FOR INDUSTRY

W C Dickinson 30 Dec 1980 10 p refs Presented at 3d Ann Systems Simulation Economic Analysis/Solar Heating and Cooling Operational Results Conf Reno Nev 27 Apr 1981

(Contract W-7405-eng-48)

(UCRL-85327 CONF-810405-11) Avail NTIS

HC A02/MF A01

02 SOLAR ENERGY

Three methods of financing large capital-intensive industrial solar systems are examined: conventional end-user financing, conventional lease financing, and the solar management company/limited partnership (SMC). The primary disadvantage of the first method is the large capital investment required of the end-user. The availability of investment capital is limited and other investment priorities are dominant. In the latter two methods the end-user is not required to provide any front-end capital. The SMC structure is attractive in that the end-user pays only for solar energy delivered to the process and is not required to operate and maintain the system. Certain types of initial government assistance are needed to make this financing technique feasible. DOE

N81-27145*# Jet Propulsion Lab California Inst of Tech Pasadena
ASSESSMENT OF SOLAR-ASSISTED GAS-FIRED HEAT PUMP SYSTEMS
F L Lansing In its The Telecommun and Data Acquisition Rept 15 Jun 1981 p 154-190 refs

Avail NTIS HC A11/MF A01 CSCL 10A

As a possible application for the Goldstone Energy Project the performance of a 10 ton heat pump unit using a hybrid solar gas energy source was evaluated in an effort to optimize the solar collector size. The heat pump system is designed to provide all the cooling and/or heating requirements of a selected office building. The system performance is to be augmented in the heating mode by utilizing the waste heat from the power cycle. A simplified system analysis is described to assess and compute interrelationships of the engine, heat pump and solar and building performance parameters, and to optimize the solar concentrator/building area ratio for a minimum total system cost. In addition four alternative heating cooling systems commonly used for building comfort are described their costs are compared and are found to be less competitive with the gas solar heat pump system at the projected solar equipment costs. T M

N81-27221*# National Aeronautics and Space Administration Washington D C
PROCESS FOR PURIFICATION OF SILICON
Helmz-Joerg Rath Erhard Sirtl and Waldemar Pfeiffer Feb 1981 11 p refs Transl into ENGLISH from German Patent no 2722783 application date 20 May 1977 30 Nov 1978 p 1-7 Transl into ENGLISH by Scientific Translation Service Santa Barbara Calif Original doc prep by Wacker-Chemitronic Co for Basic Electronic Materials Inc
(Contract NASw-3198)
(NASA-TM-76557) Avail NTIS HC A02/MF A01 CSCL 07D

The purification of metallurgically pure silicon having a silicon content of more than 95% by weight is accomplished by leaching with an acidic solution which substantially does not attack silicon. A mechanical treatment leading to continuous particle size reduction of the granulated silicon to be purified is combined with the chemical purification step. E D K

N81-27598*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
HEAT TRANSPARENT HIGH INTENSITY HIGH EFFICIENCY SOLAR CELL Patent Application
J C Evans, Jr inventor (to NASA) Filed 15 May 1981 13 p (NASA-Case-LEW-12892-1 US-Patent-Appl-SN-264380) Avail NTIS HC A02/MF A01 CSCL 10A

A heat transparent high intensity solar cell with improved efficiency is described. The surface of each solar cell has a plurality of grooves. Each groove has a vertical face and a slanted face that is covered by a reflecting metal. Light rays are reflected from the slanted face through the vertical face where they traverse a photovoltaic junction. As the light rays travel to the slanted face of an adjacent groove they again traverse the junction. The underside of the reflecting coating directs the light rays toward the opposite surface of solar cell as they traverse the junction again. When the light rays travel through the solar cell and reach the saw toothed grooves on the under side the process of reflection and repeatedly traversing the junction again takes place. The light rays ultimately emerge from the solar cell. These solar cells are particularly useful at very high levels of insolation because the infrared or heat radiation passes through the cells without being appreciably absorbed to heat the cell. NASA

N81-27599*# National Aeronautics and Space Administration Pasadena Office Calif
A STABLE DENSITY-STRATIFICATION SOLAR POND Patent Application
Fikry L Lansing, inventor (to NASA) (JPL California Inst of Tech Pasadena) Filed 30 Apr 1981 15 p
(Contract NAS7-100)
(NASA-Case-NPO-15419-1 US-Patent-Appl-SN-259208) Avail NTIS HC A02/MF A01 CSCL 10A

A solar pond for collecting and storing solar thermal energy includes a container having one section characterized by an internal wall of a substantially cylindrical configuration and a second section having an internal wall of a substantially truncated conical configuration surmounting and in coaxial alignment with the first section. The second section is characterized by a base of a diameter substantially equal to the diameter of the first section and a truncated apex defining a solar energy acceptance opening. A body of immiscible liquids is disposed within the container and comprises a first portion substantially filling the first section of the container and a second portion substantially filling the second section of the container. The first portion is of a darker color than the second portion and of a greater density. A protective cover plant is removably provided for covering the acceptance opening. NASA

N81-27601*# Jet Propulsion Lab California Inst of Tech Pasadena
THE 17TH PROJECT INTEGRATION MEETING Progress Report, Sep 1980 - Feb 1981
R R McDonald Feb 1981 508 p refs Meeting held at Pasadena Calif, 4-5 Feb 1981
(Contract NAS7-100 Contract EX-76-A-29-1012)
(NASA-CR-164553 JPL-Pub-81-35 DOE/JPL-1012/54 PR-17) Avail NTIS HC A22/MF A01 CSCL 10A

Progress made by the Low-Cost Solar Array Project during the period September 1980 to February 1981 is described. Included are reports on project analysis and integration technology development in silicon material large-area silicon sheet and encapsulation production process and equipment development engineering and operations. A report on and copies of visual presentations made at the Project Integration Meeting held at Pasadena California on February 4 and 5 1981 are also included. Author

N81-27602*# Jet Propulsion Lab, California Inst of Tech Pasadena
THE 1-KW SOLAR STIRLING EXPERIMENT Final Report
A Giandomenico 15 May 1981 107 p refs
(Contract NAS7-100)
(NASA-CR-164530 JPL-Pub-81-38) Avail NTIS HC A06/MF A01 CSCL 10A

The objective of this experiment was to demonstrate electrical power generation using a small free-piston Stirling engine and linear alternator in conjunction with a parabolic solar collector. A test bed collector formerly used at the JPL Table Mountain Observatory was renovated and used to obtain practical experience and to determine test receiver performance. The collector was mounted on a two-axis tracker with a cold water calorimeter mounted on the collector to measure its efficiency while a separate independently tracking radiometer was used to measure solar insolation. The solar receiver was designed to absorb energy from the collector then transfer the resulting thermal energy to the Stirling engine. Successful testing of receiver/collector assembly yielded valuable inputs for design of the Stirling engine heater head. Author

N81-27605*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COMPARATIVE RADIATION TESTING OF SOLAR CELLS FOR THE SHUTTLE POWER EXTENSION PACKAGE
Cosmo R Baraona Clifford K Swartz and Russell E Hart Jr 1981 4 p refs Presented at the 15th Photovoltaic Spec Conf Kissimmee Fla 12-15 May 1982 sponsored by IEEE (NASA-TM-82656, E-922) Avail NTIS HC A02/MF A01 CSCL 10A

The Power Extension Package (PEP) is the prime focus of a development program to produce low cost solar cells. The PEP is a 32 kilowatt flexible substrate retrievable solar array system for use on the Space Shuttle. Solar cell cost will be reduced by increasing cell area and simplifying cell and coverglass fabrication processes and specifications. The cost goal is to produce

cells below \$30 per watt Two and ten ohm-cm silicon cells were investigated This paper describes a unique radiation damage test and side-by-side comparison of candidate cell types with pre-and post-irradiation airplane calibration of outer space short-circuit current Author

N81-27609*# AIA Research Corp Washington D C
INTEGRATED RESIDENTIAL PHOTOVOLTAIC ARRAY DEVELOPMENT Quarterly Report

G C Royal III 10 Apr 1981 63 p refs Sponsored by NASA and DOE Prepared for JPL (Contract JPL-955893)

(NASA-CR-164617 DOE/JPL-955893-81/1 JPL-9950-559 QR-1) Avail NTIS HC A04/MF A01 CSCL 10A

Sixteen conceptual designs of residential photovoltaic arrays are described Each design concept was evaluated by an industry advisory panel using a comprehensive set of technical economic and institutional criteria Key electrical and mechanical concerns that effect further array subsystem development are also discussed Three integrated array design concepts were selected by the advisory panel for further optimization and development From these concepts a single one will be selected for detailed analysis and prototype fabrication The three concepts selected are (1) An array of frameless panels/modules sealed in a T shaped zipper locking neoprene gasket grid pressure fitted into an extruded aluminum channel grid fastened across the rafters (2) An array of frameless modules pressure fitted in a series of zipper locking EPDM rubber extrusions adhesively bonded to the roof Series string voltage is developed using a set of integral tongue connectors and positioning blocks (3) An array of frameless modules sealed by a silicone adhesive in a prefabricated grid of rigid tape and sheet metal attached to the roof DOE

N81-27610*# Westinghouse Electric Corp Pittsburgh Pa
LOW COST SOLAR ARRAY PROJECT PRODUCTION PROCESS AND EQUIPMENT TASK A MODULE EXPERIMENTAL PROCESS SYSTEM DEVELOPMENT UNIT (ME-PSDU) Quarterly Report, 1 Mar - 31 May 1981

31 May 1981 44 p

(Contract JPL-955909)

(NASA-CR-164624 DOE/JPL-955909-81/2 JPL-9950-560 QR-2) Avail NTIS HC A03/MF A01 CSCL 10A

Several major modifications were made to the design presented at the PDR The frame was deleted in favor of a frameless design which will provide a substantially improved cell packing factor Potential shaded cell damage resulting from operation into a short circuit can be eliminated by a change in the cell series/parallel electrical interconnect configuration The baseline process sequence defined for the MEPSON was refined and equipment design and specification work was completed SAMICS cost analysis work accelerated format As were prepared and computer simulations completed Design work on the automated cell interconnect station was focused on bond technique selection experiments A R H

N81-27611*# Optical Coating Lab Inc City of Industry Calif
PHOTOELECTRONICS DIV

SILICON SOLAR CELL PROCESS DEVELOPMENT, FABRICATION AND ANALYSIS Quarterly Report, 1 Oct - 31 Dec 1980

H I Yoo P A Hies and D C Leung 31 Dec 1980 54 p refs Sponsored by NASA Prepared for JPL

(Contract JPL-955089)

(NASA-CR-164618 DOE/JPL-955089-80/10 JPL-9950-561 QR-8) Avail NTIS HC A04/MF A01 CSCL 10A

Solar cells from HEM Dendritic Webs and EFG ribbons were fabricated and characterized The HEM solar cells showed only slight enhancement in cell performance after gettering steps (diffusion glass) were added Dendritic webs from various growth runs indicated that performance of solar cells made from the webs was not as good as that of the conventional CZ cells The EFG ribbons grown in CO ambient showed significant improvement in silicon quality E D K

N81-27612*# Lockheed Missiles and Space Co Sunnyvale Calif

LASER ANNEALING OF ION IMPLANTED CZ SILICON FOR SOLAR CELL JUNCTION FORMATION Final Report

J S Katzoff Jun 1981 76 p refs

(Contract JPL-955696)

(NASA-CR-164625 DOE/JPL-955696-81/4 JPL-9950-562)

Avail NTIS HC A05/MF A01 CSCL 10A

The merits of large spot size pulsed laser annealing of phosphorus implanted Czochralski grown silicon for junction formation of solar cells are evaluated The feasibility and requirements are also determined to scale-up a laser system to anneal 7.62 cm diameter wafers at a rate of one wafer/second Results show that laser annealing yields active defect-free shallow junction devices Functional cells with AM 1 conversion efficiencies up to 15.4% for 2 x 2 cm and 2 x 4 cm sizes were attained For larger cells 7.62 cm dia., conversion efficiencies ranged up to 14.5% Experiments showed that texture etched surfaces are not compatible with pulsed laser annealing due to the surface melting caused by the laser energy When compared with furnace annealed cells the laser annealed cells generally exhibited conversion efficiencies which were equal to or better than those furnace annealed In addition laser annealing has greater throughput potential M G

N81-27616*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio

METHOD OF FORMING OXIDE COATINGS Patent Application

G E McDonald inventor (to NASA) Filed 10 Jun 1981 7 p (NASA-Case-Lew-13132-1, US-Patent-Appl-SN-272152) Avail NTIS HC A02/MF A01 CSCL 10A

This invention is concerned with an improved plating process for covering a substrate with a black metal oxide film The invention is particularly directed to making a heating panel for a solar collector A compound is electrodeposited from an aqueous solution containing cobalt metal salts onto a metal substrate This compound is converted during plating into a black highly absorbing oxide coating which contains hydrated oxides This is achieved by the inclusion of an oxidizing agent in the plating bath The inclusion of an oxidizing agent in the plating bath is contrary to standard electroplating practice The hydrated oxides are converted to oxides by treatment in a hot bath such as boiling water An oxidizing agent may be added to the hot liquid treating bath NASA

N81-27620*# Honeywell Systems and Research Center
Minneapolis Minn

SPECTROPHOTOVOLTAIC ORBITAL POWER GENERATION, PHASE 2 Final Report, Aug 1980 - Mar 1981

Sau Kwan Lo David Stoltzman Gary Knowles and Ray Lin 1 Apr 1981 107 p refs

(Contract NAS8-33511)

(NASA-CR-161813 HONEYWELL-81SRC35) Avail NTIS HC A06/MF A01 CSCL 10A

A subscale model of the spectral splitting concentrator system with 10 aperture is defined and designed The model is basically a scaled down version of Phase 1 design with an effective concentration ratio up to 1000 1 The system performance is predicted to be 21.5% for the 2 cell GaAs/Si system and 20% for Si/GaAs at AM2 using realistic component efficiencies Component cost of the model is projected in the \$50K range Component and system test plans are also detailed Author

N81-27626# California Univ Fullerton

SOLAR ENERGY STORAGE PROJECTS Final Report

John Olmsted III Donald E Garrett (Garrett Energy Research and Engineering Co) Marvin L Stary (Stary (Marvin L), Claremont Calif) Jurg Bieri (Heliodyne Inc), and Fritz Haas (North Bay Research) Sep 1980 118 p refs

(Contracts FG03-78SF-01964 FG03-78SF-01929

FG03-78ET-10734 FG03-78ET-20208 Grants

EM-78-G-03-19642 EM-78-G-03-01929 EM-78-G-03-1991

EM-78-G-03-1930)

(DOE/SF-01964/T1 DOE/SF-01929/T1, DOE/ET-10734/T1

DOE/ET-20208/T1) Avail NTIS HC A06/MF A01

Four reports are included on idea and hardware development of photochemical, glauber salt, stratifiable liquid thermal, and modular concrete block energy storage strategies Separate abstracts are prepared for three DOE

N81-27627# AIA Research Corp Washington D C

PASSIVE SOLAR DESIGN FINAL EVALUATION, THE PASSIVE STUDIO

Aug 1980 9 p refs

(Contract DE-AC02-79CS-30120)

(DOE/CS-30120/1) Avail NTIS HC A02/MF A01

02 SOLAR ENERGY

The further evaluation of the workshops in passive design for practicing architects and engineers through delayed interviews with a sample of the participants is reported with particular emphasis on the extent to which the participants have practiced passive design in the three to four months since attending. Also discussed is an unsuccessful attempt to conduct a lower cost version of the program outside of normal office hours. Finally the follow-on programs and improvements that the interviews indicated are needed are identified. DOE

N81-27631# Midwest Research Inst Golden Colo
ANALYSIS OF HYBRID SOLAR SYSTEMS
J Swisher Oct 1980 6 p refs Presented at the AS of ISES Passive Solar Conf, Amherst, Mass, 19-25 Oct 1980 (Contracts DE-AC02-77CH-00178 EG-77-C-01-4042) (SERI/TP-721-825 CONF-801016-19) Avail NTIS HC A02/MF A01

The TRNSYS simulation program was used to evaluate the performance of active charge/passive discharge solar systems with water as the working fluid. TRNSYS simulations are used to evaluate the heating performance and cooling augmentation provided by systems in several climates. The results of the simulations are used to develop a simplified analysis tool similar to the F-chart and Phi-bar procedures used for active systems. This tool currently in a preliminary stage should provide the designer with quantitative performance estimates for comparison with other passive active and nonsolar heating and cooling designs. DOE

N81-27643# Exxon Enterprises Burlington Mass Solar Thermal Systems Div
PERFORMANCE OF A SOLAR-HEATING MODULE FOR COMMERCIAL-GREENHOUSE USE, PHASE 5 Final Report
John M Buchanan Jan 1981 40 p refs (Contracts DE-AC05-77CS-35299 EG-77-C-05-5299) (DOE/CS-35299/T2) Avail NTIS HC A03/MF A01

A large solar heat collector was constructed to assist the heat loads of a greenhouse. The collector is an insulated black cavity with forced air circulating to transfer the solar energy to water storage via air to water heat exchangers. Performance records indicate that the annual collection is 20 percent of the solar radiation received and lower than the 50 percent originally estimated. The years required before positive cash flow is established is increased from 10 to 25 years for a typical projection study. Recommendations are made for improving the solar collection module which currently has a performance that does not recommend its cavity-type design. DOE

N81-27646# Puerto Rico Univ Mayaguez
DEVELOPMENT AND ANALYSIS OF A LINEARLY SEGMENTED CPC COLLECTOR FOR INDUSTRIAL STEAM GENERATION M S Thesis
Jose Alberto Atienza Figueroa Figueroa Jun 1980 170 p refs (Contract DE-AC05-76OR-00033) (DOE/ER-00033/T4) Avail NTIS HC A08/MF A01

The mirror consists of long and narrow planar segments placed inside sealed low-cost glass tubes. The absorber is a cylindrical fin inside an evacuated glass tube. The optical efficiency of the segmented concentrator was simulated by means of Monte-Carlo Ray-Tracing program. Laser Ray-Tracing techniques were also used to evaluate the possibilities of this new concept. A preliminary evaluation of the experimental concentrator was done using a relatively simple method that combines results from two experimental measurements: overall heat loss coefficient and optical efficiency. A transient behavior test was used to measure to overall heat loss coefficient throughout a wide range of temperature. DOE

N81-27647# Dynamics Technology Inc Torrance Calif
TECHNICAL ASSESSMENT OF AN AEROELECTRIC SOLAR POWER CONCEPT
E C James Feb 1981 113 p refs (Contract DE-AC01-80ER-10192) (DOE/ER-10192/T1) Avail NTIS HC A06/MF A01

The evaluation was based on a one dimensional flow analysis which invokes the conservation of mass, momentum and energy of the fluid mixture (air, water vapor and water droplets) flowing through the powerplant. A performance evaluation computer code

was developed which can be used to assess the concept under diverse conditions of the powerplant was specified. Aerodynamic flow losses were using a compendium of pipe flow data for each component of the power plant. These losses are utilized in the flow analysis. Flow losses were estimated to be approximately one third of the stream's dynamic pressure in the tower's cylinder section. Geometric or configuration changes can be made to reduce aerodynamic loss. DOE

N81-27651# Sandia Labs Albuquerque N Mex Central Receiver Test Facility Div
HELIOSTAT OPERATION AT THE CENTRAL RECEIVER TEST FACILITY Technical Report, Oct 1978 - Dec 1980
J T Holmes May 1981 23 p refs (Contract DE-AC04-76DP-00789) (SAND-81-0275) Avail NTIS HC A02/MF A01

The data and conclusions reported are for 222 CRTF heliostats. The CRTF beam produces a total power of 5.5 MWth and a peak intensity of 2250 KW/sq m near solar noon. Improvements in the targeting accuracy were made. The mirror reflectivity is maintained near 80% by cleaning with natural rains or snow. The CRTF logged almost 300,000 operating hours by the end of 1980. DOE

N81-27652# Sandia Labs Albuquerque, N Mex
SYSTEMATIC ROTATION AND RECEIVER-LOCATION ERROR EFFECTS ON PARABOLIC-TROUGH ANNUAL PERFORMANCE
George H Treadwell and Norman R Grandjean Apr 1981 13 p refs (Contract DE-AC04-76DP-00789) (SAND-81-0159) Avail NTIS HC A02/MF A01

The technique for calculating the influence of systematic errors on performance is outlined. Methods for identifying and minimizing these errors are suggested. DOE

N81-27653# Sandia Labs Albuquerque N Mex Experimental Systems Operation Div
MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY PREDICTIONS FOR THERMAL PERFORMANCE BASED ON TEST DATA TOLTEC TWO-AXIS TRACKING SOLAR COLLECTOR WITH 3M ACRYLIC FILM REFLECTOR SURFACE
Thomas D Harrison Jun 1981 15 p refs (SAND-80-1964/12) Avail NTIS HC A02/MF A01

The solar collector has potential for use in industrial process heat and enhanced oil recovery applications. Predictions are for three output temperatures at five cities in the United States. T M

N81-27654# Sandia Labs Livermore Calif Energy Systems Studies Div
COMPARISON OF ALTERNATIVE WASHING SYSTEMS FOR HELIOSTATS
A Kerstein Apr 1981 23 p refs (Contract DE-AC04-76DP-00789) (SAND-81-8207) Avail NTIS HC A02/MF A01

Two methods are proposed for washing heliostat mirrors in a solar central receiver facility. One method involves truck mounted washing mechanisms continuously traversing the heliostat field washing mirrors sequentially on a fixed schedule. The other concept involves a washing unit affixed to each heliostat permitting near simultaneous washing of all heliostats on demand. The former, scheduled washing system has the advantage of lower capital costs while the latter responsive system has more operational flexibility. Cost benefit evaluation of the two systems taking into account the random nature of rainfall patterns and soiling processes indicates that the scheduled system is preferable. DOE

N81-27659# Los Alamos Scientific Lab N Mex Solar Energy Group
SOLAR ENERGY RESEARCH AT LOS ALAMOS Progress Report, 1 Apr - 30 Sep 1980
Sherry K Reisfeld comp and Donald A Neep comp Mar 1981 45 p refs (Contract W-7405-eng-36) (LA-8782-PR) Avail NTIS HC A03/MF A01

Research is described on collector testing, the National Security and Resources Study Center active system study,

monitored buildings data analysis and performance predictions for passive solar heated buildings Salinity gradient solar pond theoretical calculations the thermosyphon collector experiment and solar materials analysis and testing are described Accounts are also given of technical support to the Office of Solar Applications for Buildings US Department of Energy and of technology transfer to the scientific community building industry government departments and the general public DOE

N81-27671# Westinghouse Electric Corp Pittsburgh Pa Advanced Energy Systems Div
DESIGN REPORT WESTINGHOUSE SECOND GENERATION HELIOSTAT VOLUME 2 'MANUFACTURING, INSTALLATION, TRANSPORTATION, AND COST ESTIMATES

Jun 1980 46 p refs

(Contract DE-AC04-76DP 00789)

(SAND-79-8193/2) Avail NTIS HC A03/MF A01

A manufacturing plan is given to define the strategy to be used to build heliostats in large volume for solar central receiver power plants generating power commercially in field arrays of 3956 heliostats to produce 50 megawatts of electric power and to show how the plan will be implemented Plans are presented for parts and materials procurement the needed capital equipment plant equipment and production equipment The processes for assembling and installing the heliostats and the personnel required for the job are discussed as well as field maintenance and quality control Assembly plant capacity and the heliostat production schedule are estimated Cost estimates are tabulated for production operation and maintenance of heliostats DOE

N81-27676# Sandia Labs Albuquerque N Mex Systems Analysis Div.

ANALYTICAL MODELS FOR SOLAR-PHOTOVOLTAIC ENERGY-SYSTEM COMPONENTS

M W Edenburn Apr 1981 147 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-2567) Avail NTIS HC A07/MF A01

Analytical models for components used in solar photovoltaic energy systems were incorporated into subroutines that are part of the solar energy system analysis computer program SOLSYS Array thermal models calculate cell temperature and illumination for flat point focus and line focus arrays Electrical subsystem models compute array power output (based on array current voltage characteristics) battery parameters and power conditioning equipment efficiencies Cooling towers are modeled to determine coolant temperature for activity cooled arrays A solar and weather data subroutine reads typical meteorological year tapes and computes solar azimuth and elevation angles DOE

N81-27677# Sandia Labs Livermore Calif

DESIGN, COST AND PERFORMANCE COMPARISONS OF SEVERAL SOLAR THERMAL SYSTEMS FOR PROCESS HEAT VOLUME 5 SYSTEMS

P J Eicker Joe D Hankins Larry D Hostetler Joseph J Iannucci and James B Woodard Apr 1981 78 p refs

(Contract DE-AC04-76DP-00789)

(SAND-79-8283-Vol-5) Avail NTIS HC A05/MF A01

Conceptual designs were obtained for central receiver parabolic dish and parabolic trough systems used in several industrial process heat applications The estimated cost of energy from these systems is presented The system level trade studies which determined the optimal collector spacings are discussed The assumptions used in the study relative to economics maturity of technologies costs of nonsolar equipment nomenclature etc are also presented The appendices discuss the models used to calculate field performance and present detailed information on subsystem cost and performance DOE

N81-27679# Sandia Labs Albuquerque, N Mex

MIDTEMPERATURE SOLAR SYSTEMS TEST FACILITY PREDICTIONS FOR THERMAL PERFORMANCE BASED ON TEST DATA POLISOLAR MODEL POL SOLAR COLLECTOR WITH GLASS REFLECTOR SURFACE

Thomas D Harrison May 1981 25 p ref

(Contract DE-AC04-76DP-00789)

(SAND-80-1964/11) Avail NTIS HC A02/MF A01

Thermal performance predictions based on test data are presented for the Polisolar Model PQL sola collector with glass reflector surfaces for three output temperatures at five cities in the United States DOE

N81-27680# Esser (Klaus) GmbH and Co KG Duesseldorf (West Germany) Bereich Entwicklung

SOLAR COLLECTORS FOR FLAT ROOFS Final Report

Guenter Dohse and Guenter Reisewitz Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 30 p In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-043 ISSN-0340-7608

BMFT-03E4017B/ETS8001A) Avail NTIS HC A03/MF A01

The development and construction of solar collectors for flat roofs preparation for production and service life qualification testing are described Optimization of collector parts considering the choice of material and manufacturing techniques was investigated The problematic nature of installation techniques which meet technical requirements and guarantee good operation is addressed Solar collector heat transfer characteristics are shown satisfactory while wind tunnel and weathering environment tests demonstrate the ruggedness of engineering models For connecting the collector to the interior piping customized roof penetrating connector elements and pipe support brackets are used

Author (ESA)

N81-27681# Promotor Verlags und Foederungsges m b H Karlsruhe (West Germany)

PESA PRACTICAL EXPERIENCES WITH EXISTING SOLAR ENERGY INSTALLATIONS Final Report

Guenther Keller and Juergen Uhlig Bonn Bundesministerium fuer Forschung und Technologie Nov 1980 79 p In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-073 ISSN-0340-7608)

Avail NTIS

HC A05/MF A01

A total of 494 solar energy installations operating in the Federal Republic of Germany were investigated by way of interviews with the owners and circulation of questionnaires A representative number of each type of domestic solar energy system presently in use was surveyed and data concerning installation (size cost difficulty) application (eg hot water space heating) and maintenance were tabulated Results provide basic data on solar energy technology as well as showing that approximately 80% of all solar plant owners are generally satisfied with their installations

Author (ESA)

N81-27685# Hydronamic N V Shiedrecht (Netherlands)

STUDY OF INFRASTRUCTURE CONSIDERATIONS FOR MICROWAVE ENERGY GROUND RECEIVING STATIONS SATELLITE POWER SYSTEM (SPS) OFFSHORE RECTENNA SITING STUDY IN WESTERN EUROPE AN EXECUTIVE SUMMARY Final Report

A R Bresters Paris ESA Nov 1980 26 p refs

(Contract ESTEC-4382/80-NL-PP(SC))

(P-495-Vol-1 ESA-CR(P)-1411-Vol-1)

Avail NTIS

HC A03/MF A01

The feasibility of offshore rectenna sites in the North Sea based on a reference SPS concept of 5 GW was investigated Site criteria include a 20 km wide safety zone between the site and the shore, a 300 km limit to centers of power consumption and a water depth of 30 m Artificial islands polders atolls and exposed gravity or jacket structures were considered Only the island and polder concept permit antenna installation without modifications to the reference design The polder concept was selected costing half that of the artificial island (160 km sq) Construction material requirements are given for the dikes Total construction time is 8.5 years Costs range between 4.7 and 5.4 billion in 1980 dollars or \$0.02 per kw hr over 30 years

Author (ESA)

N81-27687# National Bureau of Standards Washington D C National Engineering Lab

NBS SOLAR COLLECTOR DURABILITY/RELIABILITY TEST PROGRAM PLAN Final Report

David Waksman Elmer Streed and James Seiler Jan 1981 90 p refs Sponsored in part by DOE

(PB81-166571, NBS-TN-1136)

Avail NTIS

HC A05/MF A01 CSDL 10A

The program is designed to evaluate both approved and proposed solar collector test procedures and to correlate laboratory accelerated field and simulated operational exposures with actual field data The tests and exposure procedures described determine the influence of environmental exposure parameters that could affect the degradation of solar collectors and their

02 SOLAR ENERGY

materials They provide a correlation between changes that occur at the materials and the collector component levels GRA

N81-27690# National Bureau of Standards, Washington D C
National Engineering Lab
MEASUREMENT TECHNIQUES FOR SOLAR CELLS Final
Annual Report, 15 Dec 1978 - 14 Dec 1979
D E Sawyer, K K Kessler, T J Russell W F Lankford and
H A Schafft Jan 1981 61 p refs Sponsored in part by
Midwest Research Inst
(PB81-163875, NBSIR-80-2181) Avail NTIS
HC A04/MF A01 CSCL 10B

The laser scanner was used to examine a variety of devices
Cu₂S/Cds cells, silicon tandem junction cells Zn₃P₂ Schottky
diode specimens, and edge-fed growth polycrystalline silicon cells
It is possible to detect cell design and processing induced losses
in conversion efficiency areas of missing antireflection coatings,
lack of ohmic contact of the metallization to the cell, breaks in
cell metallization fingers, fine cracks scratches and silicon carbide
inclusions GRA

N81-27926*# National Aeronautics and Space Administration
Langley Research Center, Hampton, Va
**SOLAR-DRIVEN LIQUID METAL MAGNETOHYDRODYNAMIC
GENERATOR**
Ja H Lee (Vanderbilt Univ) and Frank Hohl May 1981 16 p
refs
(NASA-TM-81965) Avail NTIS HC A02/MF A01 CSCL 20I

A solar oven heated by concentrated solar radiation as the
heat source of a liquid metal magnetohydrodynamic (LMMHD)
power generation system is proposed The design allows the
production of electric power in space as well as on Earth, at
high rates of efficiency Two types of the solar oven suitable for
the system are discussed Author

N81-27976*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
**HIGHLIGHTS OF NASA/DOE PHOTOVOLTAIC MARKET
ASSESSMENT VISIT TO MOROCCO**
9 Jun 1981 11 p refs
(NASA-TM-82288) Avail NTIS HC A02/MF A01 CSCL
05C

A broad range of agricultural, rural development, and other
power applications in various regions of Morocco were examined
to determine the potential market for photovoltaic products in
Moroccan development. The primary focus of the study was the
agriculture sector which accounts for approximately 17% of the
country's GNP The country has a clear need for reliable remote
power systems, but does not have the financial resources to
invest in the relatively high capital cost PV equipment A modest
potential for PV use was identified in nonagricultural rural services,
such as refrigerators for rural clinics and rural radio-telephones
The main potential for PV in Morocco in the next five years lies
mainly in the telecommunications sector Applications include
rural TV sets, TV repeater stations, microwave relay stations,
and railroad, marine, and airline signalling Market size estimates
were derived from development and expansion plans At an
average customer cost for complete installed systems from
\$18/Wp to \$30/Wp the total potential market value is estimated
in the range of \$6.6 to \$11 million over the 1981-1986 period
A R H

03 HYDROGEN

Includes hydrogen production, storage, and distribution

A81-30648 A theoretical estimation of the parameters of influence on the discharge of a metal hydride storage container for hydrogen (Theoretische Abschätzung von Einflussparametern auf den Entladevorgang eines Wasserstoff-Metallhydridspeichers) B Luxenburger and F Schafer *Wärme- und Stoffübertragung*, vol 15, no 1, 1981, p 17-26 13 refs In German

A81-31816 Use of hydrides in motor vehicles J Topler, O Bernauer, and H Buchner (Daimler-Benz AG, Stuttgart, West Germany) *Journal of Materials for Energy Systems*, vol 2, Sept 1980, p 3-10 10 refs

Results of research on hydrogen driven vehicles and hydride storage tanks are presented, along with a detailed discussion of the operational possibilities of low temperature hydrides, such as TiFeH₂, and of high temperature hydrides, such as Mg₂NiH₄. Attention is given to their cyclization stability and thermal conductivity. Heat storage and heat recovery with the aid of hydrides are discussed, and a theoretical hydride storage capacity of a Mg-Ni-alloy is presented. It was concluded that all hydride tanks will be 10 to 20 times heavier than the conventional gasoline tank. The problems of tank weight and gasoline shortage can be solved by a combination hydrogen/gasoline fuel. Existing energy infrastructures must be utilized, as the setting up of a hydrogen infrastructure is, at the present time, both technically and economically unfeasible. K S

A81-34243 * Rating hydrogen as a potential aviation fuel R D Witcofski (NASA, Langley Research Center, Hampton, Va) *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif, Oct 13-16, 1980, Paper 80-1152* 11 p 25 refs

The viability of liquid hydrogen, liquid methane, and synthetic aviation kerosene as future alternate fuels for transport aircraft is analyzed, and the results of a comparative assessment are given in terms of cost, energy resource utilization, areas of fuel production, transmission airport facilities, and ultimate use in the aircraft. Important safety (fires) and some environmental aspects (CO₂ balance) are also described. It is concluded that fuel price estimates indicate the price of synthetic aviation kerosene (synjet) would be approximately half of the price calculated for liquid hydrogen and somewhat less than that of liquid methane, with synjet from oil shale reported to be the least expensive. E B

A81-34244 Status of the program to develop LH₂ for aircraft G D Brewer (Lockheed-California Co., Burbank, Calif) *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif, Oct 13-16, 1980, Paper 80-1153* 11 p 6 refs

The first research and development phase of a comprehensive program proposed for the proving of liquid hydrogen (LH₂) as an aircraft fuel is described. After consideration of synthetic jet fuel and liquid methane as additional alternatives for the replacement of petroleum-derived Jet A, and the advantages of LH₂ noted, detailed attention is given such issues as the global availability, low pollution combustion products, relative safety, process energy requirements, direct operating costs, and the detailed concerns of an international, coordinated research effort for the period 1981-83. This program addresses three major areas of development: (1) aircraft and engine studies, (2) aircraft and engine development, and (3) hydrogen production and ground facilities. The program is estimated to cost \$73.6 million. O C

A81-39299 Use of photoelectric generators to produce hydrogen from water M Ia Bakirov and D T Efendiev (Akademii Nauk Azerbaidzhanskoi SSR, Sektor Radiatsionnykh Issledovaniy, Azerbaidzhan SSR) (*Geliotekhnika*, vol 16, no 4, 1980, p 43-45) *Applied Solar Energy*, vol 16, no 4, 1980, p 42-44 Translation

The basic design of a plant for the production of hydrogen from

water by the use of photoelectric generators is examined. The plant consists of a solar battery made up of a modular array of silicon photocells capable of generating 8 A at 12 V at solar maximum, a cylindrical electrolyzer, and a control unit designed to regulate the pressure of the gases released and maintain a constant pressure differential between them. Measurements of the volt-ampere characteristics of the facility at various solar radiation intensities have shown that only 43 W out of a maximum power of 96 W is used by a single electrolyzer, and that two electrolyzers connected in series make use of 76 W of generator power. Maximum productivities of 3.3 liters of H₂/hr and 1.6 liters of O₂/hr and 6.4 liters of H₂/hr and 3 liters of O₂/hr were measured for the single and two-cell configurations, respectively, with 50 l of H₂ generated during a 10-hr solar day at an overall plant efficiency of 3%. Calculations have shown that a solar battery of 1-sq m area and 20% efficiency will produce over 2000 cu m of hydrogen over a 25 year service life, sufficient for providing remote regions with hydrogen fuel. The combined use of photoelectric and wind power generating facilities has also been proposed. S C S

A81-39990 The economics of hydrogen as a fuel J O Bockris (Texas A & M University, College Station, TX) *International Journal of Hydrogen Energy*, vol 6, no 3, 1981, p 223-241 29 refs

Second Law costs, the costs of fuel conversion, and the costs of environmental and health hazards, constitute real economics. The costs of various competing fuels should be compared for the time at which they will be used, and the building of machinery required for new fuels should begin before the end of the exhausting sources and before the new fuel becomes competitive in the market sense. First Law costs of hydrogen from coal average \$4/MBtu compared to \$11/MBtu from electrochemical water splitting, \$13/MBtu from thermal water splitting and \$19/MBtu from photo-based methods. Biomass might prove to be a cheaper fuel source than coal, but only in countries with large desert areas. H₂ shows an 1.5 times increase in burning efficiency compared to gasoline, and pollution costs would be 13-30% of the cost of a fuel from coal, with an added 30% for the cost of H₂ gas storage in cars. Synthetic gasoline could not be made after 2010, due to the greenhouse effect, but H₂ could be made from coal until 2040, if CO₂ is rejected into the ocean. Amortization problems limit the building of new coal plants to 2010, and potentially cheap water splitting concepts are being investigated, which use concentrated solar light and lower irradiation. J F

A81-39991 Hydrogen as an activating fuel for a tidal power plant A M Gorlov (Northeastern University, Boston, MA) *International Journal of Hydrogen Energy*, vol 6, no 3, 1981, p 243-253 7 refs Research sponsored by the U.S. Department of Energy

Tidal projects, offering a clean, inexhaustible, and fairly predictable energy source, require a system for accumulating energy for off-peak periods. Hydrogen produced by electrolysis during off-peak power plant operation can be used as an activating fuel to furnish the plant during peak load demands. Tidal energy is converted into compressed air energy by special chambers on the ocean bed. This compressed air can be heated by combustion of the stored hydrogen and expanded through high speed gas turbine generators. For off-peak periods, the energy of non-heated compressed air is used for the production of hydrogen fuel. The amount of fuel produced at this time is enough for power plant operation during two peak hours, with three times greater plant capacity. The hydrogen fuel storage method does have energy losses and requires extra capital investment for electrolysis and hydrogen storage equipment. It does not, however, require a gas turbine oil fuel, as does the air compressed storage method, nor a low-speed heavy hydro turbine, as does the hydro pumped method. Moreover, the gas turbine can be used for both production and consumption of hydrogen fuel. J F

A81-39994 Mixing effects of metal hydrides on equilibrium behavior and reaction kinetics S Suda, Y Komazaki, and N Kobayashi (Kogakuin University, Hachioju, Japan) *International Journal of Hydrogen Energy*, vol 6, no 3, 1981, p 275-284 9 refs

Experimental studies are carried out to test the equilibrium behavior and hydriding and dehydriding properties of binary mixtures of LaNi₅/TiMn1.5, MnNi₅/TiMn1.5, MnNi₄8Al0.2/TiMn1.5, and LaNi₅/Ti0.8Zr0.2Cr0.8Mn1.2 under isothermal con-

03 HYDROGEN

ditions of 30 60 deg C with 10 deg intervals The mixing of metal hydrides is valuable in designing thermodynamic cycles, since it gives desirable PTC properties, enhances reaction rate, and increases the available temperature and pressure ranges Adding a small amount of a more reactive hydride into a less reactive hydride is effective in improving the kinetics where rapid reaction speed with a reasonable PTC relationship is required, and in increasing availability with an increased available temperature band Mixed metal hydrides also increase the useability of low grade energy sources, such as industrial waste heat, solar, geothermal, oceanic thermal, and atmospheric energies J F

N81-24289# California Univ, Livermore SYNUELS FROM FUSION: PRODUCING HYDROGEN WITH THE TANDEM MIRROR REACTOR AND THERMO- CHEMICAL CYCLES, VOLUME 1

F L Ribe and R W Werner 21 Jan 1981 84 p refs.
(Contract W-7405-eng-48)
(UCID-18909-Vol-1) Avail NTIS HC A05/MF A01

The combination of a fusion reactor driver and a thermochemical plant were examined as a means for producing synthetic fuel in the basic form of hydrogen The following topics were studied (1) the tandem mirror reactor, particularly the simple central cell geometry and direct electrical output, (2) a liquid metal cauldron design and a flowing Li₂O solid microsphere pellet design comparing the technology, the thermal hydraulics, neutronics, and tritium control in a high temperature operating mode, and (3) three thermochemical cycles, processes in which water is used as a feedback along with a high temperature heat source to produce H₂ and O₂ DOE

N81-24290# California Univ, Livermore SYNUELS FROM FUSION: PRODUCING HYDROGEN WITH THE TANDEM MIRROR REACTOR AND THERMO- CHEMICAL CYCLES

R W Werner (Washington Univ, Seattle) 21 Jan 1981
482 p refs
(Contract W-7405-eng-48)
(UCID-18909-Vol-2) Avail NTIS HC A21/MF A01

The tandem mirror fusion driver, the cauldron blanket module, and the flowing microsphere are discussed Other topics include coupling the reactor to the process the thermochemical cycles and chemical reactors and process units DOE

N81-24296# Oak Ridge National Lab Tenn Chemical Technology Div

HYDROGEN PRODUCTION BY PHOTOSYNTHESIS
Elias Greenbaum 1981 14 p refs Presented at the 5th Ann
IGT Meeting on Energy from Biomass and Wastes Lake Buena
Vista Fla 26-30 Jan 1981
(Contract W-7405-eng-26)
(CONF-810116-1) Avail NTIS HC A02/MF A01

The photoevolution of hydrogen and oxygen by photosynthesis is an approach to the problem of solar energy conversion The roles of Photosystem 2 and the electron transport chain of photosynthesis in providing reducing equivalents which are eventually evolved as molecular hydrogen are presented Experimental data are presented on two systems capable of simultaneous photoproduction of molecular hydrogen and oxygen The first is a green algal system The second is a non-living cell-free system comprised of isolated chloroplasts, ferredoxin, and hydrogenase Both the reduction side of Photosystem 2 as well as endogenous reductants R (interacting directly with the electron transport chain) provide electrons which are evolved as molecular hydrogen These data suggest that the photochemical machinery of photosynthesis is used to perform true photosynthetic water splitting i.e. 2H₂O yields 2H₂+O₂ DOE

N81-24593# Staatliches Forschungsinstitut fuer Geochemie Bamberg (West Germany)

**INVESTIGATION OF THE INFLUENCE OF ADDITIVES ON
THE STORAGE OF HYDROGEN IN ALLOYS COMPOUND-
ING WITH INTERMETALLICS [UNTERSUCHUNGEN UEBER
DEN EINFLUSS VON ZUSATZEN AUF DIE SPEICHERUNG
VON WASSER-STOFF IN LEGIERUNGEN BZW INTERME-
TALLISCHEN VERBINDUNGEN]**

H Meier Bonn Bundesministerium der Verteidigung 1980
103 p refs In GERMAN ENGLISH summary
(BMVG-FBWT-80-10) Avail NTIS HC A06/MF A01

The reversible storage of hydrogen in metals and alloys is described and the possibility of improving hydrogen storage

systems with additives is discussed Thermodynamic and kinetic data (hydrogen storage capacity dissociation enthalpy 1 bar decomposition temperature absorption and desorption rates activation energy) are given for FeTi alloys and Mg alloy systems It is shown that in FeTi alloys the highest hydrogen weight content can be obtained by alloying 2 to 4 mass % cerium Moreover hysteresis in pressure composition isotherms can be diminished, replacing Fe in FeTi containing misch metal by Zr or Mn In Mg/Ni alloys with low nickel content an enhancement of the atom ratio H/M (up to 1.7, corresponding to G sub H = 6.2 % H₂) is possible by the addition of small amounts of other elements Kinetic experiments show that binary and ternary Mg alloy systems are characterized by rapid dehydrogenating rates (1 to 2 hr at 300 C) and rapid hydriding kinetics, i.e. a negative temperature dependence (2 to 4 min at 245 C) Author (ESA)

N81-25254# Los Alamos Scientific Lab, N Mex THERMOCHEMICAL PROCESSES FOR HYDROGEN PRODUCTION Progress Report, 1 Oct 1979 - 30 Sep 1980

C M Hollabaugh comp Mar 1981 20 p refs
(Contract W-7405-eng-36)
(LA-8675-PR) Avail NTIS HC A02/MF A01

The work consists of experimental and engineering research to define cycles that can be coupled feasibly to high temperature heat sources for water splitting to produce hydrogen and oxygen In recent months, our efforts were directed toward improving the design and operation of our 1 in diam laboratory scale quartz rotary kiln Our results from the decomposition of bismuth oxy-sulfate in the kiln shows the technical feasibility of solid sulfate decomposition in a flow mode with recycled feed in residence times less than 2 min Other work included (1) engineering studies than compared the published estimates of capital costs and process efficiencies for hydrogen production by thermochemical means and by electrolysis (2) coordination of US contributions to the annual International Energy Agency Technical Workshop on Thermochemical Processes DOE

N81-26215# California Univ, Livermore Lawrence Livermore Lab

**PRELIMINARY RESULTS OF THERMAL IGNITER EXPERI-
MENTS IN H SUB 2-AIR-STEAM ENVIRONMENTS**

William Lowry Jan 1981 32 p refs Presented at the Workshop
on the Impact of Hydrogen on Water Reactor Safety Albuquerque,
N Mex 25-28 Jan 1981
(Contract W-7405-eng-48)

(UCRL-84167-Rev-1 CONF-810120-3-Rev-1) Avail NTIS
HC A03/MF A01

Thermal igniters (glow plug) proposed by the Tennessee Valley Authority for intentional ignition of hydrogen in nuclear reactor containment used for functionality in mixtures of air, hydrogen, and steam Test environments included 6% to 16% hydrogen concentrations in air, and 8% 10%, and 12% hydrogen in mixtures with 30% and 40% steam fractions All were conducted in a 10.6 cu ft insulated pressure vessel For all of these tests the glow plug successfully initiated combustion Dry air/hydrogen tests exhibited a distinct tendency for complete combustion at hydrogen concentrations between 8% and 9% Steam suppressed both peak pressure and completeness of combustion No combustion could be initiated at or above a 50% steam fraction Circulation of the mixture with a fan increased the completeness of combustion The glow plug showed no evidence of performance degradation throughout the program DOE

N81-27617*# National Aeronautics and Space Administration, Washington D C

**USE OF REVERSIBLE HYDRIDES FOR HYDROGEN
STORAGE**

B Darriet, M Pezat and P Hagenmuller Dec 1980 18 p
refs Transl into ENGLISH from Proceedings of the 1st Seminar
on Hydrogen as an Energy Vector Its Production, Use and
Transportation (Belgium), 1978 p 393-406 Conf held in Brussels
3-4 Oct 1978 sponsored by the Luxembourg Commission of
the European Communities Original language document was
announced as A80-15991 Transl. by Scientific Translation
Service Santa Barbara, Calif
(Contract NASw-3198)

(NASA-TM-75723) Avail NTIS HC A02/MF A01 CSCL
10C

The addition of metals or alloys whose hydrides have a high dissociation pressure allows a considerable increase in the

hydrogenation rate of magnesium. The influence of temperature and hydrogen pressure on the reaction rate were studied. Results concerning the hydriding of magnesium rich alloys such as Mg_2Ca , $\text{La}_2\text{Mg}_{17}$ and CeMg_{12} are presented. The hydriding mechanism of $\text{La}_2\text{Mg}_{17}$ and CeMg_{12} alloys is given. Author

FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels nuclear fuels, geothermal and ocean thermal energy tidal energy and wind energy

A81-30455 Selective detection of uranium by laser-induced fluorescence - A potential remote sensing technique I - Optical characteristics of uranyl geologic targets II - Experimental assessment of the remote sensing of uranyl geologic targets J P deNeufville (Energy Conversion Devices, Inc., Morristown, N.J.), A Kasdan, and R J L Chimenti (Exxon Corporate Research Science Laboratories, Linden, N.J.) *Applied Optics*, vol 20, Apr 15, 1981, p 1279-1307 46 refs

The remote sensing of laser-induced uranyl ion fluorescence is discussed as a potential indicator of uranium occurring in geologic materials at the earth's surface. The paper studies the optical characteristics of uranyl geologic targets, and reports measurements made of the time-dependent relative fluorescence brightness, the excitation and emission spectra, the fluorescence lifetime and the fluorescence quantum yield of over 100 uranyl-bearing and nonuranyliferous mineral, rock and soil samples using pulsed laser excitation at 4250 Å and detection within a 50 Å bandwidth at 5250 Å. High fluorescence yields are found for uranyl minerals such as meta-autunite, liebigite and andersonite, ranging from 0.42 to 0.8. In addition, a laser system for the experimental assessment of the remote sensing of uranyl geological targets has been developed. A relationship is derived for the signal-to noise power ratio (S/N) of a fluorescence measurement, and limitations to the sensitivity which are imposed by system parameters and noise sources are examined. The dependence of S/N on the surface area concentration of the uranyl mineralization, the laser excitation parameters, the background illumination, the range and the observation time is demonstrated. D K

A81-31047 Kinetics of coal hydrogenation B L Bhatt (Brookhaven National Laboratory, Upton, N.Y.) and E N Ziegler (New York, Polytechnic Institute, Brooklyn, N.Y.) *Institute of Energy, Journal*, vol 54, Mar 1981, p 12-20, 28 refs. Research supported by the U.S. Department of Energy.

A kinetic study of coal devolatilization and hydropyrolysis is conducted using 15 to 20 mg of coal at 10.4 MPa pressure. Batch experiments are performed at less than or equal to 625 °C/s heating rates by passing electric current through stainless steel screens containing known weights of dry pulverized North Dakota lignite. Kinetic data are obtained from the weight loss of coal and from the concentrations of the evolved products, measured by a gas chromatograph. At 10.4 MPa, no significant amounts of hydrocarbons were obtained from coal devolatilization in helium alone. For the order of reaction $n = 6$, a reasonably good fit was found for 21 data points with overall correlation coefficient 0.62, having 95% confidence limits of 0.26 and 0.83. The activation energy was estimated to be about 205 kJ/mole which is consistent with the assumption that chemical reaction is the rate-controlling step. D K

A81-31507 Interpretation of self potential survey results from the East Mesa geothermal field, California R F Corwin, G T DeMouilly, R S Harding, Jr., and H F Morrison (California, University, Berkeley, Calif.) *Journal of Geophysical Research*, vol 86, Mar 10, 1981, p 1841-1848 26 refs. U.S. Geological Survey Grant No 14 08-0001-16546

A dipolar self-potential anomaly of approximately 90 mV peak-to-trough amplitude and 5 km peak-to-trough length is measured over the East Mesa geothermal field in the Imperial Valley of Southern California. A surface field similar in form to the measured self-potential anomaly is generated by a source configuration comprising dipolar current distributions along a series of three steeply dipping planes that are roughly coincident in location and

depth extent with known faults. The source currents could be generated through the interaction of heat or fluid flow with changes in thermoelectric or electrokinetic coupling coefficients across faults. Source currents associated with these currents, however, are considerably greater than those generated by estimated in situ coupling coefficients and heat and fluid flows. This implies that in situ coupling coefficients are significantly larger than those derived from room temperature measurements, that heat or fluid flows are much greater than those assumed for the East Mesa field, or that some other mechanism is responsible for the generation of the anomaly. C R

A81-31508 Economics of low temperature, direct use applications of geothermal energy. N L Book (Missouri-Rolla, University, Rolla, Mo.), L J Groome (Tulane University, New Orleans, La.), C A Bakewell, and E H Herron (Gruy Federal, Inc., Arlington, Va.) *Energy (UK)*, vol 6, Apr 1981, p 317-322 16 refs

An analysis of 20 processes utilizing low temperature geothermal energy was performed to determine the cost of delivered energy to the process. The analysis indicates that the portion of the cost associated with producing and reinjecting geothermal fluids dominates the cost of direct use applications of low temperature geothermal energy. As a result, the cost of delivered energy correlates with degree of utilization of the resource rather than the type of application. Low temperature geothermal resources can be expected to provide a competitive energy source when reinjection temperatures are low and seasonal peak demands are minimal, thus yielding high utilization rates. The cost of geothermal energy was found to be competitive with fuel-oil based energy sources at energy utilization levels above 20% of the maximum available. (Author)

A81-31864 Vertical combustor for particulate refuse P M Chung and L Carlson (Illinois, University, Chicago, Ill.) *Numerical Heat Transfer*, vol 4, Jan-Mar 1981, p 101-122 16 refs

A one-dimensional model is constructed of a vertical combustor for refuse particle combustion in order to analyze it for waste energy recovery. The three components of the model, fuel particles, inert solid particles and the gaseous mixture are described by momentum, energy, and mass conservation equations, resulting in three different flow velocities and temperatures for the medium. The gaseous component is further divided into six chemical species that evolve in combustion at temperatures below about 1367 K. A detailed description is given of the fuel particle combustion through heating, devolatilization, and combustion of the volatile gas in the boundary layer, return of the flame sheet to the fuel surface, and char combustion. The solutions show the combustor to be viable for U.S. refuse which consists of combustibles that can be volatilized up to 85 to 95% below 1366 K. Char combustion, however, is found to be too slow to be attempted in the combustor, where the fuel residence time is of the order of 2 s. D K

A81-31973 # ICRF antennae and heating studies in high density TFR plasmas J Jacquinet (EURATOM and Commissariat à l'Energie Atomique sur la Fusion, Département de Recherches sur la Fusion Contrôlée, Fontenay-aux-Roses, Hauts de Seine, France). In International Conference on Plasma Physics; Kiev International Conference on Plasma Theory, 4th, and International Congress on Waves and Instabilities in Plasmas, 4th, Nagoya, Japan, April 7-11, 1980, Proceedings Volume 2. Japan, Fusion Research Association of Japan, 1980, p 226-237 12 refs

Five hundred kW of ICRF power is launched in high density TFR plasmas where $N_{sub\ e0}$ is approximately 1.4×10^{10} to the $14\text{th}/\text{cm}^3$. Mode conversion scenario (80 percent D2, 20 percent H2) is found to be a better heating scheme than the minority regime from the point of view of heating the plasma with minimum deleterious effects. Direct RF heating of electrons by Landau damping is observed unambiguously in the mode conversion regime. C R

A81-32907 # Developing technologies for synthetic fuels F B Sprow (Exxon Research and Engineering Co., Florham Park,

N J) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0836* 7 p

After consideration of a likely timetable for the development of a synthetic fuels industry and its necessary supporting technology, the large variety of such fuels and their potential roles is assessed along with their commercialization outlook. Among the fuel production methods considered are (1) above-ground retorting of oil shale, (2) in-situ shale retorting, (3) open pit mining of tar sands, (4) in-situ steam stimulation of tar sands, (5) coal gasification, (6) methanol synthesis from carbon monoxide and hydrogen, and (7) direct coal liquefaction by the hydrogenation of coal. It is shown that while the U.S. has very limited resource bases for tar sands and heavy crudes, the abundance of shale in the western states and the abundance and greater geographical dispersion of coal will make these the two most important resources of a future synthetic fuels industry. O C

A81-33554 # Radio-physical methods for the monitoring of the environment (Radiofizicheskie metody distantsionnogo izucheniia okruzhayushchei sredy). N. A. Armand, A. E. Basharinov, L. F. Borodin, E. N. Zotova, and A. M. Shutko. In *Problems of present-day radio engineering and electronics*. Moscow, Izdatel'stvo Nauka, 1980, p. 95-138. 140 refs. In Russian.

Microwave methods for the remote sensing of earth resources are discussed, with emphasis on theoretical and experimental studies of the microwave emission properties of natural objects. The use of such methods in oceanography, geology, hydrology, and agriculture is considered. Recent literature in this domain is reviewed. P T H

A81-33876 # Future U.S. jet fuels - A refiner's viewpoint. K. H. Strauss (Texaco, Inc., Beacon, N.Y.). *AIAA, SAE, ASCE, ATRIF, and TRB, International Air Transportation Conference, Atlantic City, N.J., May 26-28, 1981, AIAA Paper 81-0770* 7 p. 6 refs.

Future trends in jet fuel quality are examined in terms of available refinery charge stocks and competition with other products. The processing requirements of differing alternative crude sources are reviewed, highlighting the problem of hydrogen availability for anticipated processing. The role and impact of alternatives to petroleum crudes are reviewed and the resultant effect on jet fuel quality is presented. Increasing competition for middle distillates and decreasing competition for lighter naphtha fractions is pointed out as is the importance of balancing jet fuel quality against aircraft and engine development and operating costs. Continuing research to develop information for such studies is recommended. (Author)

A81-34177 * Some advantages of methane in an aircraft gas turbine. R. W. Graham and A. J. Glassman (NASA, Lewis Research Center, Cleveland, Ohio). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801154* 9 p. 22 refs.

Because liquid methane may be obtained from existing natural gas sources or produced synthetically from a range of other hydrocarbon sources (coal, biomass, shale, organic waste), it is considered as an aviation fuel in a simplified cycle analysis of the performance of a turboprop engine intended for operation at Mach 0.8 and 10,688 m altitude. Performance comparisons are given for four cases in which the turbine cooling air is either not cooled or cooled to -111, -222, and -333 K, and the advantages and problems that may be expected from direct use of the cryogenic fuel in turbine cooling are discussed. It is shown that while (1) methane combustion characteristics are appreciably different from those of Jet A fuel and will require the development of different combustor designs, and (2) the safe integration of methane cryotanks into transport aircraft structures poses a major design problem, a highly fuel-efficient turboprop engine fueled by methane appears to be feasible. O C

A81-34619 # Digital differential rectification of air-borne MSS data for geothermal mapping. M. Nasu, K. Shimamoto, H. Kano, and M. Fuchimoto (Asia Air Survey Co., Ltd., Tokyo, Japan). In *International archives of photogrammetry, International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980, Presented Papers. Volume 23, Part B 9. Commissions 1, 2, 3 & 4. Supplement (A81-34606 15-43)*. Hamburg, Committee of the International Congress for Photogrammetry, 1980, p. 454-470. 6 refs.

A81-34646 # Applications of remote sensing to oceanography and sea ice. R. Thoren (Forsvarets Forskningsanstalt, Stockholm, Sweden). In *International archives of photogrammetry, International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980, Presented Papers. Volume 23, Part B 10. Commissions 6, 7 & 8*. Hamburg, Committee of the International Congress for Photogrammetry, 1980, p. 662-725.

It is pointed out that Arctic resources represent about 40% of the oil and gas potential of all the world. Minerals are other primary products of great economic value. The importance of navigation in ice covered sea areas becomes evident in this connection. Ice studies and remote sensing as an aid to navigation are consequently very important. Attention is given to the Committee for High Arctic Research Liaison and Information Exchange, a planned Swedish Arctic Interdisciplinary Expedition, exploration and transportation of natural resources in ice covered sea areas, a comprehensive remote sensing experiment on sea ice, atmospheric and oceanic research, glacial extent and climatic variations, pollution problems as studied in bottom sediments, submarine volcanism and the history of the continental margins, and marine biology. G R

A81-35599 Biomass energy from crop and forest residues. D. Pimentel (New York State College of Agriculture and Life Sciences, Ithaca, N.Y.), M. A. Moran, S. Fast, G. Weber, R. Bukantis, L. Balliett, P. Boveng, C. Cleveland, S. Hindman, and M. Young. *Science*, vol. 212, June 5, 1981, p. 1110-1115. 81 refs. Research supported by the Rockefeller Foundation and Mobil Foundation, NSF Grant No. 77-05332.

Residues remaining after the harvest of crop and forestry products are being proposed as a substantial energy source for the nation. An estimated 22 percent of the residues might be utilized, providing a renewable source of high grade energy with the potential of supplying 1 percent of the current U.S. gasoline consumption as ethanol or 4 percent of the total electrical energy used. These net energy benefits are limited by high energy costs to collect, transport, and process the residues. Environmental threats include soil erosion, water runoff, and nutrient loss. (Author)

A81-35726 # Methodological aspects of using remote sensing data in oil and gas exploration (Metodicheskie aspekty ispol'zovaniia materialov distantsionnykh s'emok v neftegazopiskovykh rabotakh). M. I. Kostriukov and P. T. Tsarenko (GlavTiumen'-neftegaz, Tyumen, USSR). *Issledovanie Zemli iz Kosmosa*, Mar.-Apr. 1981, p. 9-13. 8 refs. In Russian.

The use of remote sensing data for oil and gas exploration in the central part of the western Siberian plain is considered. Techniques to increase the efficiency of interpretation of deep structures are examined, and the necessity of augmenting the development of automated interpretation systems is emphasized. B J

A81-35770 A time-domain technique for measurement of the dielectric properties of oil shale during processing. M. F. Iskander, A. L. Tyler, and D. F. Elkins (Utah, University, Salt Lake City, Utah). *IEEE, Proceedings*, vol. 69, June 1981, p. 760-762. 14 refs.

A time domain technique for the measurement of the dielectric properties of oil shale over a broad frequency range is described. The advantages of this technique, which can be used to study chemical changes occurring during the rapid heating of the shale, include simplicity of the procedure, relatively cheap equipment required, and the considerably shorter time to do the measurements as compared with frequency-domain methods. Preliminary results illustrate the feasibility of this method. B J

A81-35799 The high-temperature Winkler process - A way for the generation of synthesis gas from lignite (Das Hochtemperatur-Winkler-Verfahren - Ein Weg zur Erzeugung von Synthesegas aus Braunkohle). H. Teggers and L. Schrader (Rheinische Braunkohlenwerke AG, Cologne, West Germany). *Energiewirtschaftliche Tagesfragen*, vol. 31, May 1981, p. 397-399. In German.

The generation of gas from coal becomes increasingly important in connection with the continuously rising cost of petroleum. The lignite found in the Rhine area of West Germany is especially well suited as a raw material for the generation of synthesis gas, because

mining conditions are favorable and the material is highly reactive. Criteria for the selection of a process for the generation of synthesis gas from lignite are examined. It is found that processes involving medium gasification temperatures and the employment of a fluidized bed are particularly well suited. The high-temperature Winkler process has the required particularly well suited. The high-temperature Winkler process has the required characteristics. Attention is given to process development, details of process implementation, and the results obtained during the operation of an experimental installation. G R

A81-35800 Development and state of the art regarding lignite power stations (Entwicklung und Stand von Braunkohlenergiekraftwerken) H Krost and H Vetter *Energiewirtschaftliche Tagesfragen*, vol 31, May 1981, p 402-405, 408-410 16 refs In German

In 1980 about 20-25% of the electric energy generated in West Germany was obtained by using lignite as fuel. An employment of raw lignite as fuel presents special problems in connection with the high water content of the material (from 50% to 60%), the ash content (from 5 to 15%), and the high percentage of volatile components. Preparation processes which transform the raw lignite into a form which is suitable for a use as fuel are discussed, taking into account also the combustion temperatures and the required air ratio. The introduction of power stations with a 'block' structure is considered. Boiler, turbine, and recoling plant form a unit, which can operate by itself without any connection to an adjacent unit. A 600 MW 'block' stage represents the current state of technology. Attention is also given to environmental conditions, waste heat utilization, reductions in fuel oil consumption of power stations, availability and reliability, operational life, renovation requirements, and new developments. G R

A81-35990 # Fuels from renewable resources L Hoffmann, C Schnell, and G Gieseler *Dornier-Post* (English Edition), no 1, 1981, p 22-24

Consideration is given to fuel substitution based on regenerative plants. Methanol can be produced from regenerative plants by gasification followed by the catalytic hydration of carbon oxides. Ethanol can be used as a replacement fuel in gasoline and diesel engines and its high knock rating allows it to be mixed with lead free gasoline. Due to the depletion of oil and gas reserves, fermentation alcohol is being considered. The raw materials for the fermentation process can potentially include (1) sugar (such as yeasts, beet or cane sugar), (2) starch (from potatoes or grain) and (3) cellulose which can be hydrolyzed into glucose for fermentation. S C S

A81-36278 Significant results from using earth observation satellites for mineral and energy resource exploration W D Carter (US Geological Survey, Earth Resources Observation Systems Office, Reston, Va) (COSPAR, Topical Meeting - Sessions on Remote Sensing 1980, Budapest, Hungary, June 2-14, 1980) *Advances in Space Research*, vol 1, no 10, 1981, p 261-269 24 refs

The use of earth observation satellites for mineral and energy exploration is discussed in terms of the different systems now in existence, which provide improved data on the surface reflectance (Landsat), thermal emission (HCMM), and the magnetic variations (Magsat) of the earth's surface and crust. The operational application of the data in the construction of global, specified geological, and metallogenic maps, indicating mineral and energy resources, is pointed out. Further application for petroleum and geobotanical exploration and the monitoring capabilities of the data with regards to dynamic environmental and geological processes, such as volcanic activities, floods, and meteorological aspects, is discussed. It is concluded that the Seasat and GEOS satellites have proven that the L-Band (25 cm) synthetic aperture radar, and radar altimetry function from space can provide accurate surface information even during cloud formation. E B

A81-37415 Civil aircraft design for fuel reduction W Tye *Aeronautical Journal*, vol 85, Apr 1981, p 134-142 11 refs

Various considerations regarding civil aircraft design for fuel reduction are assessed. Long and short-term energy supplies are noted and aviation fuel costs are discussed. Growth trends in air traffic are estimated and alternate fuels are considered. The design

factors having particular significance to fuel economy are identified as specific fuel consumption, lift/drag ratio and aircraft weight relative to the payload carried. Engine developments are considered along with aerodynamic gains, improved structural materials and active control technology. Potential radical advances are identified as laminar flow aircraft and turbo props. S C S

A81-37565 Cultivation and utilization of new biomass resources - An aquatic weed, water hyacinth T Kobayashi (Ministry for Agriculture, Forestry and Fisheries, National Food Research Institute, Ibaraki, Japan) and K Ueki (Kyoto, University, Kyoto, Japan) (*Kagaku to Seibutsu*, vol 18, no 4, 1980, p 231-236) *Energy Developments in Japan*, vol 3, Jan 1981, p 285-300 24 refs Translation

A81-37998 Analysis of reverse combustion in tar sands A Amr (Wyoming, University, Laramie, WY) *Combustion and Flame*, vol 41, June 1981, p 301-312 10 refs Contracts No E(29-2)-3694, No EY-77-C-04-3913

This paper describes a one dimensional numerical model that simulates oil recovery from tar sands by reverse combustion. The method of lines is used to solve the nonlinear differential equations describing the flow. The effects of volumetric air flux on the peak temperature, flame velocity, and oil recovery efficiency are reported. The results are compared to the results of relevant experimental studies. (Author)

A81-38925 # Biogasification of municipal solid wastes L F Diaz, G M Savage, G J Trezek, and C G Golueke (Cal Recovery Systems, Inc., Richmond, CA) (*American Society of Mechanical Engineers, National Waste Processing Conference, Washington, DC, May 11-14, 1980*) *ASME, Transactions, Journal of Energy Resources Technology*, vol 103, June 1981, p 180-185 18 refs

A series of experiments on the anaerobic digestion of the organic fraction of municipal refuse was performed. The refuse fraction used in the study was one of the portions segregated in a resource recovery system developed at the University of California, Berkeley. The scale of experiments includes 4, 9, and 1600 L digesters. The refuse used as feed was enriched by the addition of raw sewage sludge in various ratios, i.e., from 0-100 percent of the total volatile solids. No other sources of nutrients or chemicals for pH control were introduced into the reactors. Organic loading rates ranging from 1-16.4 g of volatile solids/Ld were obtained. Typical hydraulic detention times were 15 to 30 days. Temperatures were kept within the range of 72-104 F (22-40 C). Digestion efficiency was based on energy conversion and gas production. (Author)

A81-39321 Prospecting for wind - Windmills and wind characteristics R N Meroney (Colorado State University, Fort Collins, CO) (*American Society of Civil Engineers, Annual Convention and Exposition, Boston, MA, Apr 2-6, 1979*) *ASCE, Transportation Engineering Journal*, vol 107, July 1981, p 413-426 18 refs

A review and critical assessment of wind prospecting methodologies is presented. It is shown that (1) the production of equivalent wind speed data near ground level (less than 100 m) requires accurate reproduction of surface roughness, shape, and vegetation. While adequate for certain dispersion simulations, terraced models are not appropriate for wind turbine site selection, (2) current meteorological data in complex terrain is not yet adequate as a supplier of inflow conditions for either numerical or physical models, and (3) physical modeling was able to reproduce the relative wind speeds found over complex terrain, by rank, to sample correlation coefficient levels of 0.79-0.95, day-to-day quantitative wind speeds to 0.70-0.76, wind speeds to 0.81, and day-to-day site wind directions to 0.65-0.67. O C

A81-39981 Alternative aircraft fuels - When will the action start C Bulloch *Interavia*, vol 36, July 1981, p 715-717

A comparative study is presented of the relative advantages and disadvantages of the development and use, in the near future, of synthetic Jet A fuel ('synjet'), liquid hydrogen, liquid methane, and alcohol. In all cases, the aircraft for which the fuels are considered is a Mach 0.85 cruise, turbofan powered airliner. In addition to performance figure comparisons for short, medium and long range flights, the alternative fuels are considered from the viewpoint of

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cost, process energy expenditure and capital investment. Attention is also given to the problem arising from the physical properties of liquefied, cryogenic fuels such as hydrogen and methane, and the extensive redesign of both airframe and airport facilities that they entail. It is concluded that despite the low pollution, high-energy combustion characteristics of hydrogen, synjet fuel is a more reliable and less expensive alternative for next-generation aircraft. O C

A81-40147 * # Navigation errors encountered using weather-mapping radar for helicopter IFR guidance to oil rigs. J D Phillips, J S Bull, D M Hegarty, and D C Dugan (NASA, Ames Research Center, Moffett Field, CA). In American Helicopter Society, Annual Forum, 36th, Washington, DC, May 13-15, 1980, Proceedings. Washington, DC, American Helicopter Society, 1980. 10 p. 5 refs (AHS 80-16)

In 1978 a joint NASA FAA helicopter flight test was conducted to examine the use of weather mapping radar for IFR guidance during landing approaches to oil rig helipads. The following navigation errors were measured: total system error, radar range error, radar-bearing error, and flight technical error. Three problem areas were identified: (1) operational problems leading to pilot blunders, (2) poor navigation to the downwind final approach point, and (3) pure homing on final approach. Analysis of these problem areas suggests improvement in the radar equipment, approach procedure, and pilot training, and gives valuable insight into the development of future navigation aids to serve the offshore oil industry. (Author)

A81-40199 Gasification of agricultural residues for energy production. M Laurin and A Chamberland (Hydro Quebec, Institut de Recherche, Varennes, Canada). *Energy Sources*, vol 5, no 4, 1981, p. 361-380. 15 refs. Research supported by the Agriculture Canada and Supply and Services Canada.

A technical and economic evaluation has been made of the possibility of producing gas from agricultural residues on typical farms in western and eastern Canada. A preliminary assessment shows that, as far as the western farm is concerned, the cost of collecting the required residues would be prohibitive in view of the enormous areas involved, in the east, on the other hand, where heating represents a far greater proportion of a farmer's expenses, collection and conversion of the residues to thermal energy would be a relatively minor expense. The study points out the advantages of extracting energy from corn cobs for heating greenhouses and drying grain. For the specific need to be met here, namely heating the air in a grain dryer or in a greenhouse, the best conversion system, therefore, would be a gas-producing device. For ease of operation, it is recommended that a gasifier-type reactor be used, preferably the fixed bed type, which is reliable and straightforward to operate. (Author)

A81-40330 A method for satellite identification of surface temperature fields of subpixel resolution. J Dozier (NOAA, National Earth Satellite Service, Washington, DC). *Remote Sensing of Environment*, vol 11, July 1981, p. 221-229. 14 refs.

It is possible to measure surface radiant temperature fields of subpixel spatial resolution from satellites which contain more than one channel in the thermal infrared spectral region. Because of the different response of the Planck function at different wavelengths, the radiant temperatures measured in two channels may be expressed in terms of contributions from two temperature fields, each occupying a portion of the pixel, where the portions are not necessarily contiguous. The resulting simultaneous nonlinear equations may be solved for the complementary portions of the pixel occupied and one unknown temperature. In two adjacent pixels which can be assumed to have the same target temperatures and same background temperatures, both unknown temperatures may be found. (Author)

N81-22092# Battelle Pacific Northwest Labs., Richland, Wash. **MUTAGENIC AND CHEMICAL PROPERTIES OF SRC-1 MATERIALS** Progress Report, 1 Mar. 1980 - 28 Feb. 1981. R A. Pelroy, ed., D S Sklarew, A Tosto, and B W Wilson. Jan 1981. 33 p. refs. (Contract DE-AC06-78RL-01830)

(PNL-3604) Avail: NTIS HC A03/MF A01

Process solvent (PS) and solid product (dissolved in organic solvent) produced by the solvent refined coal (SRC-I) process contain mutagenically active components against the Ames-Salmonella strains, *Salmonella typhimurium* TA98 and TA100. Ames positive mutagens are apparently concentrated in the moderately polar to strongly polar chemical constituents of both materials. However, the dissolved solid product contains a much higher proportion of very strongly polar mutagens, and may be enriched in acidic, i.e., oxygen containing mutagens. DOE

N81-22093# California Univ., Livermore. Lawrence Livermore Lab.

UTILIZATION OF OIL SHALES AND BASIC RESEARCH IN ORGANIC GEOCHEMISTRY

A K Burnham. 13 Jan 1981. 15 p. refs.

(Contract W-7405-eng-48)

(UCID-18891) Avail: NTIS HC A02/MF A01

Research needs relating to oil shale utilization which might also provide insight into the organic geochemistry of the Green River formation are discussed. Two general topics cross boundaries and are worthy of emphasis. The first is a study of changes in the kerogen structure and biological markers with depth and location, and how these changes affect the pyrolysis products. The second is a study of the haterostom chemistry of the kerogen and how it relates to mineral matter and trace metals. This would be useful not only to present utilization methods, but also might suggest new nonthermal methods of organic materials recovery. DOE

N81-22141# Energy and Environmental Research Corp., Santa Ana, Calif.

SOOT FORMATION IN SYNTHETIC-FUEL DROPLETS Quarterly Technical Progress Report, Oct - Dec 1980.

G England, J Kramlich, and R Payne. Jan 1981. 14 p. refs. (Contract DE-AC22-80PC-30298)

(DOE/PC-30298/T1, QTPR-1) Avail: NTIS HC A02/MF A01

Detailed information is given on methods of minimizing soot formation during synthetic liquid fuel combustion under conditions which minimize fuel nitrogen conversion to nitric oxide. Fuel screening studies investigate the impact of fuel properties on particulate production, establish the importance of droplet size and examine atomizer effects and develop techniques for surrogate fuels. Flame studies investigate soot formation from synfuel droplet combustion configurations in variable slip velocity configurations. DOE

N81-22142# Energy and Environmental Research Corp., Santa Ana, Calif.

ASSESSMENT OF PULVERIZED COAL-FIRED COMBUSTOR PERFORMANCE Quarterly Technical Progress Report.

W Richter, W Clark, and R Payne. Jan 1981. 26 p. refs.

(Contract DE-AC22-80PC-30297)

(DOE/PC-30297/T1, QTPR-1) Avail: NTIS HC A03/MF A01

An assessment of the performance of industrial furnaces firing pulverized coal incorporates two experimental tasks and is constructed around an analytical task which identifies and upgrades the family of computer programs required to undertake the performance analysis studies. These analytical tools are used to predict the effect of parameters such as fuel type and furnace variables on combustor performance, and to identify those properties which have a major impact on thermal performance. The second task uses a combustion reactor to screen the key variables identified and to provide data on the properties of coal particulate matter which affect heat transfer performance. Verification of the engineering analytical approach is provided by measurements made in a pilot-scale furnace. DOE

N81-22143# Argonne National Lab., Ill. Energy and Environmental Systems Div.

PULSE COMBUSTION TECHNOLOGY FOR HEATING APPLICATIONS Quarterly Progress Report, 1 Jul - 30 Sep 1980.

C A Blomquist, J M Clinch, and H P Egbert. Nov 1980. 23 p. refs.

(Contract W-31-109-eng-38)

(ANL/EES-TM-117) Avail: NTIS HC A02/MF A01

A technology base for fossil fuel-fired pulse combustion heating systems is developed. Design data and design procedures for pulse combustion burners are proposed. Basic performance characteristics, including heat transfer rates, thermal efficiency,

noise emissions, and exhaust gas composition, are obtained as a function of the primary combustion design parameters, including combustor geometry, fuel/air ratio, valve geometry, and decoupling chamber size. A mathematical model of the combustor is developed for use as an engineering design tool in establishing combustor geometry for specific applications and for defining trade-offs between system efficiency, noise emissions, and cost. Noise and pressure-fluctuation data are characterized and analyzed with respect to frequency and amplitude. Preliminary experimental and analytical investigations are initiated to develop a basis for extending the pulse combustion concept to liquid and solid fuel-burning systems. DOE

N81-22146# University of Southern California, Los Angeles
CHEMISTRY AND STRUCTURE OF COAL DERIVED ASPHALTENES AND PREASPHALTENES Quarterly Progress Report, Apr. - Jun 1980
T F Yen 1980 97 p refs
(Contracts DE-AC01-76ET-10626 EX-76-C-01-2031)
(FE-2031-17) Avail NTIS HC A05/MF A01

The asphaltene and preasphaltene fractions are isolated from coal liquids from a number of liquefaction processes. These processes consist of in general catalytic hydrogenation, staged pyrolysis and solvent refining. The asphaltene fractions may be further separated by both gradient elution through column chromatography, and molecular size distributions through gel permeation chromatography. Those coal derived asphaltene and preasphaltene fractions are investigated by various chemical and physical methods for characterization of their structures. The parameters are correlated with the refining and conversion variables which control a given type of liquefaction process. The effects of asphaltene in catalysis, ash or metal removal, desulfurization and denitrification are also correlated. DOE

N81-22153# Brigham Young Univ., Provo, Utah Combustion Lab
BASIC COMBUSTION AND POLLUTANT-FORMATION PROCESSES FOR PULVERIZED FUELS Quarterly Report, 1 Oct. - 31 Dec 1980
Geoffrey J Germane and L Douglas Smoot 15 Jan 1981 30 p refs
(Contract DE-FG22-80PC-30306)
(DOE/PC-30306/T1, QTPR-1) Avail NTIS HC A03/MF A01
The potential industrial application of pulverized fuels other than coal was investigated. Utilization problems with these fuels such as flame stability, fuel handling, pollutant emission and ash, and slag formation in large scale furnaces were examined. An extensive literature search was conducted to assess current knowledge relative to utilization of these fuels. DOE

N81-22171# Battelle Pacific Northwest Labs, Richland, Wash
APPLICATION OF LINEAR POLARIZATION TECHNIQUE TO THE MEASUREMENT OF CORROSION RATES IN SIMULATED GEOTHERMAL BRINES
M J Danielson Dec 1980 29 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3534) Avail NTIS HC A03/MF A01

The linear polarization of polarization resistance (PR) technique was investigated in high and low salinity geothermal brines at 150 and 250 C on a low carbon steel (A53B) and a ferritic stainless steel (E-brite 26-1) with and without the presence of oxygen in the brine. There was good agreement between weight loss data and the results from linear polarization data. Oxygen generally accelerated the corrosion rate, and in the presence of oxygen the usual form of the PR equation must be replaced by the mass transfer equation to predict corrosion rates correctly. Results of the study were compared with the corrosion rate output of commercial PR instrumentation and it was concluded that this instrumentation is adequate for field investigations in which oxygen is absent. However, when oxygen is present, commercial instruments may underestimate actual corrosion rates considerably. DOE

N81-22172# Ames Lab, Iowa
ALLOY EVALUATION FOR FOSSIL FUEL PROCESS PLANTS (LIQUEFACTION) Annual Report, 1 Oct. 1979 - 30 Sep. 1980
C M Woods and T E Scott Dec 1980 77 p
(Contract W-7405-eng-82)
(IS-4758) Avail NTIS HC A05/MF A01

The mechanical properties of liquefaction process plant dissolver vessel materials in a coal slurry-hydrogen environment are evaluated. The following were studied: fatigue crack growth rates in 2-1/4Cr-1Mo steel, thermal expansion coefficients of A387 316 SS and 883 steels, tensile properties of 2-1/4Cr-1Mo steel after exposure to 4000 psig H₂ at 1000 or 950 F, corrosion of 2-1/4Cr-1Mo steel by coal slurry-H₂ at 800 F and 4000 psig, analysis of coal and coal oil, and phase stability diagrams of Fe, Cr, Mo, and Mn in H₂S-H₂-C-O. DOE

N81-22207 Utah Univ., Salt Lake City
FLUIDIZED BED HYDRODESULFURIZATION OF COAL DERIVED LIQUIDS Ph.D. Thesis
Hsiang-Yun Arthur Kung 1980 148 p
Avail Univ Microfilms Order No 8106876

A bench-scale continuous 1 inch ID fluidized bed reactor system was built. Two feedstocks were used: a petroleum heavy gas oil and a coal derived liquid from Tacoma, Washington. The heavy gas oil (280-389 C) was used to adjust the system and the coal derived liquid (SRC II 200-509 C) was used to determine the effect of process variables. The catalyst was a commercial cobalt-molybdenum oxide supported on alumina ground to 49 micron size. The catalyst was sulfided prior to use. The dew point temperatures and hydrogen/oil feed ratio were determined such that vapor-phase operation could be maintained for the desired range of operation. Minimum fluidization velocities with high pressure and high temperature conditions were experimentally determined by measurement of the pressure drop through the bed of solid particles. The overall hydrodesulfurization reaction fitted a pseudo-second-order rate equation with respect to sulfur concentration at constant total pressure. The activation energy of hydrodesulfurization of SRC-II liquid ranged from 14.9 to 15.5 Kcal/g mole. Dissert Abstr

N81-22208 Missouri Univ., Rolla
CULTURE STUDIES ON THE CONVERSION OF CORN STOVER TO METHANE Ph.D. Thesis
Gary Lynn Foutch 1980 182 p
Avail Univ Microfilms Order No 8108118

The anaerobic fermentation of corn stover to methane was demonstrated to be a viable process for the conversion of this agricultural residue to a useable form of energy. With fresh cow manure as the original inoculum, digestors were operated over a period of four years at retention times varying between 20 and 100 days. A first order reaction rate constant of 0.045 per day was determined as was a maximum conversion at infinite retention of 73 percent. Several bacteria were examined to determine their ability to produce better conversion of sugars and corn stover to methanogenic substrates. Dissert Abstr

N81-22210# Chem Systems, Inc., Fairfield, NJ Research and Development Group
DEVELOPMENT OF ALCOHOL-BASED SYNTHETIC TRANSPORTATION FUELS FROM COAL-DERIVED SYNTHESIS GASES Quarterly Progress Report, 1 Apr. - 30 Jun 1980
3 Dec 1980 48 p
(Contract DE-AC22-79ET-14858)
(DOE/ET-14858/3, QPR-3) Avail NTIS HC A03/MF A01

Fourteen catalysts were prepared by either evaporation of metal nitrate-citric acid solutions or by impregnation of inert supports with metal nitrate-citric acid solutions and were tested in either the Berty gradientless reactor or the plug flow reactor. Although none of the catalysts tested resulted in reaching the targeted oxygenates selectivities and space time yields, the following relevant observations were made: potassium in a catalyst having the formula Cu/ZnO/125CoAO 11 is a better alkali promoter than cesium; impregnation of inert supports with metal nitrate citric acid solutions reduced activity and oxygen productivity in comparison to the unsupported catalyst and mechanical blending of metal oxides for a Cu/ZnO/125CoCrKO 11 results in better selectivity conversion characteristics than coprecipitation or evaporation of nitrate-citric acid solutions. DOE

N81-22211# South Carolina Energy Research Inst, Columbia Div of Energy Resources
FUEL ETHANOL AND SOUTH CAROLINA A FEASIBILITY ASSESSMENT VOLUME 1 EXECUTIVE SUMMARY
Jul 1980 37 p refs
(Contract DE-FG44-80RA-10075)
(DOE/R4-10075/T1-Vol-1) Avail NTIS HC A03/MF A01

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The production of fuel grade ethanol from grain and other carbohydrate based resources was investigated. The building of ethanol production plants to produce alternate fuels which can be burned directly in modified engines or mixed with gasoline to make gasohol is discussed. Information about the production of ethanol in small scale and major commercial facilities in South Carolina is reported. The existing carbohydrate resource base in the state, extent to which the base can be increased and out of state feedstocks to expand the base are reviewed. The economic impact, environmental impact, state requirements, use of agricultural residues, and manure derived methane are examined. E A K

N81-22212# South Carolina Energy Research Inst., Columbia **FUEL ETHANOL AND SOUTH CAROLINA A FEASIBILITY ASSESSMENT VOLUME 2. DETAILED REPORT**

Jul 1980 252 p refs

(Contract DE-FG44-80R4-10075)

(DOE/R4-10075/T1-Vol-2) Avail NTIS HC A12/MF A01

Production of ethanol from carbohydrates in the state of South Carolina is discussed. Ethanol fuels become a more significant element in South Carolina's energy mix. The existing carbohydrate resource base in the state is reviewed, the extent to which this base can be increased is estimated, and importation of out of state feedstocks to expand the base further is discussed. The economics of ethanol production for farm scale and commercial sized plants, environmental impacts and state permitting and approval requirements are discussed. The use of agricultural residues and manure derived methane to fuel the ethanol production process is addressed. DOE

N81-22216# Pittsburg and Midway Coal Mining Co., Englewood Colo **SOLVENT REFINED COAL (SRC) PROCESS Progress Report**

Dec 1980 18 p

(Contract DE-AC01-76ET-10104)

(DOE/ET-10104/T8) Avail NTIS HC A02/MF A01

The progress of the solvent refined coal (SRC) project during the month of October 1980 is summarized. The Fort Lewis pilot plant was shut down the entire month for inspection and maintenance. The process development unit P-99 completed two runs investigating potential start-up modes for the demonstration plant. E D K

N81-22217# Los Alamos Scientific Lab., N Mex **SOME IMPLICATIONS OF ACCELERATED SYNTHETIC FUELS DEVELOPMENT IN THE ROCKY MOUNTAIN STATES**

Verne Loose Nov 1980 25 p refs

(LA-8588-MS) Avail NTIS HC A02/MF A01

A regionalized national energy model is used to examine the air quality and water quantity implications of accelerated synthetic fuels development. Several alternate targeted output levels are analyzed. Generally, the results indicate that a relatively large synthetic fuels industry (2.5 million bbl/day) could be located within the Rocky Mountain and Northern Great Plains States within the confines of water availability and air quality legislation. Author

N81-22218# Battelle Pacific Northwest Labs., Richland, Wash **TRANSPORTATION FUELS FROM WOOD**

E G Baker, D C Elliott, and D J Stevens 1980 14 p refs

(PNL-SA-8584 CONF-801210-18) Avail NTIS

HC A02/MF A01

The various methods of producing transportation fuels from wood are evaluated. These methods include direct liquefaction schemes such as hydrolysis/fermentation, pyrolysis, and liquefaction. Indirect liquefaction techniques involve gasification followed by liquid fuels synthesis such as methanol synthesis or the Fischer-Tropsch synthesis. The cost of transportation fuels produced by the various methods are compared. In addition, three ongoing programs dealing with liquid fuels from wood are described. E D K

N81-22219# Chicago Univ., Ill **COAL TRANSFORMATION CHEMISTRY Quarterly Report, 1 Jun - 31 Aug 1980**

L M Stock 1980 26 p refs

(Contract DE-AC22-80PC-30088)

(DOE/PC-30088/2, QPR-2) Avail NTIS HC A03/MF A01

A proposed structure for bituminous coal is given. The facts concerning reduction, reductive alkylation, hydrogen atom exchange, oxidation, functional group analysis were used to define a structural segment consisting of about 1000 atoms with a molecular weight in excess of 6000. The reductive alkylation reaction of Illinois No. 6 coal in liquid ammonia was directed toward the optimization of the reaction conditions for the achievement of maximum solubility. About 55% of the original Illinois No. 6 coal can be converted to products which are soluble in tetrahydrofuran using potassium in liquid ammonia as the reducing agent and n-butyl iodide in tetrahydrofuran as the reducing alkylating agent. The effort on donor solvent coal chemistry was directed to the role played by pericyclic reactions in the liquefaction process. The reactivity of a number of donors was examined including 1,2- and 1,4-dihydronaphthalene. Free radical processes occur preferentially. The pericyclic reactions appear to be unimportant at the threshold reaction temperatures of 350 to 4250 C. DOE

N81-22220# Brookhaven National Lab., Upton, N Y **Process Sciences Div**

FLASH HYDROLYSIS OF COAL Quarterly Report, 1 Jan - 31 Mar 1980

Meyer Steinberg, Peter Fallon, and Bharat L. Bhatt Aug 1980 27 p refs

(Contract DE-AC02-76CH-00016)

(BNL-51293 QR-12) Avail NTIS HC A03/MF A01

Experiments were conducted using Pittsburgh No. 8 and Illinois No. 6 bituminous coals. Diluents of limestone, sand, CaO and K₂CO₃ were used to prevent agglomeration. No significant effect on product yield was observed for the various diluents. A significantly greater fraction of naphthalene was found in the heavy liquids from the bituminous coals than from the lignite and subbituminous coal. Models of the subbituminous data indicate good correlation with the experimental results. Thermodynamic equilibrium calculations indicate that the rapid hydrogasification of coal is not equilibrium controlled. DOE

N81-22221# Battelle Columbus Labs., Ohio **SYNTHETIC FUEL AROMATICITY AND STAGED COMBUSTION Quarterly Technical Progress Report, 23 Sep - 31 Dec 1980**

Arthur Levy, James R. Longanbach, and Lisa K. Chan 28 Jan 1981 21 p refs

(Contract DE-AC22-80PC-30302)

(DOE/PC-30302/1 QPR-1) Avail NTIS HC A02/MF A01

Methods for determining aromaticity and preliminary pyrolysis experiments are described. Middle and heavy distillates of a sample of SRC-II (solvent refined coal) were analyzed for elemental nitrogen, molecular weight and aromatic distribution was determined, and a simulated distillation by gas chromatography was performed. The drop tube apparatus to be used for the pyrolysis studies for the determination of the aromaticity and fuel-bound nitrogen as a function of time, temperature, and oxygen level is described. Preliminary pyrolysis experiments to determine the collection efficiency of the apparatus, the importance of drop size, and the effect of the gas flow were performed. J D H

N81-22222# Colorado School of Mines, Golden **Dept of Chemical and Petroleum Refining Engineering**

PHASE EQUILIBRIUM PROPERTIES OF COAL-DERIVED LIQUIDS Technical Progress Report, Jul. - Dec 1980

V F Yesavage and A J Kidnay 1 Jan 1981 10 p refs

(Contract DE-FG22-80PC-30230)

(DOE/PC-30230/T1) Avail NTIS HC A02/MF A01

A major difficulty associated with measuring phase behavior of complex mixtures is the need to characterize the vapor and liquid sample products. This generally requires the collection of considerable quantities of the liquid and vapor products. Of all the methods listed, the only method which can generate significant quantities of both liquid and vapor products is the once-through flow method. This method was used previously in determining the K values for petroleum fractions. For these reasons, a flow equilibrium flash vaporization system similar to the ones previously used on petroleum liquids was designed. DOE

N81-22224# TRW Systems Group, Redondo Beach, Calif **PROGRAMMED TEMPERATURE GASIFICATION STUDY Final Report, 1 Oct. 1979 - 30 Nov. 1980**

M J Spoon, M P Gardner, J A Starkovich, H L. Fein, and A J Apte 30 Nov 1980 102 p refs

(Contract DE-AC21-79MC-11630)

(DOE/MC-11630/T1) Avail NTIS HC A06/MF A01

An experimental, modeling and conceptual engineering analysis study was performed to assess the feasibility of a Programmed Temperature Gasification (PTG) concept for carbonizing caking coals without severe agglomeration. The concept involves control of carbonizing heating rate to maintain metaplast concentration at a level equal to or slightly below that which causes agglomeration. The experimental studies required construction of a programmed temperature, elevated pressure, hot stage video microscope for observation of coal particle changes during heating. This system was used to develop a minimum-time heating schedule capable of carbonizing the coal at elevated pressures in the presence of hydrogen without severe agglomeration. Isothermal fixed heating rate data for a series of coals were subsequently used to calibrate and verify the mathematical model for the PTG process. DOE

N81-22225# Sandia Labs, Livermore, Calif

HEAVY OIL PROGRAM Quarterly Progress Report, 1 Apr. - 30 Jun 1980

J R Wayland Dec 1980 33 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-2215) Avail NTIS HC A03/MF A01

Preliminary activities in the survey of sand control, drilling and fracturing techniques in heavy oil formations are described. The continued development of a high temperature packer for use in steam injection applications is presented. An application of controlled source audio magnetotelluric survey to developing thermal fronts from in situ combustion and steam drive is described. DOE

N81-22226# Department of Energy, Washington, D C Assistant Secretary for Resource Applications

TRENDS IN REFINERY CAPACITY AND UTILIZATION. PETROLEUM REFINERIES IN THE UNITED STATES, FOREIGN REFINERY EXPORTING CENTERS

E L Peer, F V Marsik and J F Hutchins Dec 1980 86 p (DOE/RA-0010-Rev-12-80) Avail NTIS HC A05/MF A01

The United States and foreign refining capacities are examined with emphasis on the growth of domestic crude oil distillation and downstream processing capacities. The growth of foreign refineries in countries which are capable of exporting products to the United States are also discussed. These data can be used to evaluate planned growth in US and foreign refinery capacities to give a perspective on the US product import situation. DOE

N81-22227# California Univ, Livermore Lawrence Livermore Lab

UNDERGROUND COAL GASIFICATION SITE SELECTION AND CHARACTERIZATION IN WASHINGTON STATE AND GASIFICATION TEST DESIGNS

R Stone and R W Hill 10 Sep 1980 61 p refs

(Contract W-7405-eng-48)

(UCRL-53052) Avail NTIS HC A04/MF A01

A site in the Tono Basin of the Centralia-Chehalis district containing subbituminous coal in two deeply buried seams (the Lower Thompson and the Big Dirty) was found to be suitable for underground coal gasification (UCG) experiments and possible commercial development. Eight exploratory boreholes and two test wells were drilled to provide the primary subsurface geologic and hydrologic information. A series of surface gasification tests using large blocks of coal cut free of the Big Dirty seam in mine exposures will be conducted to establish a preliminary set of in situ operational parameters—air injection pressures, flow rates, and coal consumption rates. If the site is suitable, the surface gasification tests will be followed by two deep underground gasification experiments: one employing borehole linking and the other reverse combustion-linking. DOE

N81-22228# UOP, Inc., Des Plaines, Ill Process Div

COAL LIQUID/PETROLEUM REFINERY INTEGRATION

George A Gilder and Vance P Burton 1980 23 p refs

Presented at the 45th Midyear Refining Meeting, Houston, Tex 15 May 1980

(Contract DE-AC01-77ET-10131)

(FE-2566-43, CONF-8005115-1 Preprint-38-80) Avail NTIS HC A02/MF A01

The economic feasibility of coprocessing H-Coal liquid and petroleum in a typical large refinery is evaluated. Existing

technology can be applied to coprocess H-Coal liquid and petroleum, it is economically feasible when the value of the H-Coal liquid is about equivalent to the value of the imported crude oil. Because of the initial investment required to handle the H-Coal liquid the processing economics are more favorable at 5% or 10% than at 3% H-Coal liquid concentration. DOE

N81-22231# Pittsburg and Midway Coal Mining Co., Shawnee Mission, Kans

EXPLORATORY RESEARCH ON SOLVENT-REFINED COAL LIQUEFACTION Quarterly Technical Progress Report, 1 Jul. - 30 Sep 1980

Feb 1981 44 p

(Contract DE-AC22-79ET-14800)

(DOE/ET-14800/25) Avail NTIS HC A03/MF A01

Disposable catalysts and the effect of specific additives in both the SRC I and SRC II processing modes were investigated. At 4500 C, 2250 psig and 10 hour residence time with Loveridge coal in the SRC II mode yields and hydrogen consumptions were essentially the same for runs with 5 wt % added pyrite or 33 wt % added ferric oxide. When Loveridge coal was impregnated with 0.7 wt % molybdenum, slightly higher oil yields and slightly lower hydrocarbon gas, SRC and IOM yields were obtained than with the iron compounds above. When Loveridge coal was processed in the SRC I mode at 4500 C, 1900 psig and 26 minutes residence time, there was a 37% increase in total oil yield with a corresponding decrease in SRC yield when pyrite was added to the feed slurry. There was a smaller effect with a FeS₂/Fe₂O₃ combination and little or no effect when ferric oxide alone was added. DOE

N81-22232# Weber State Coll., Ogden, Utah

ROLE OF THE HYDROGEN-DONOR SOLVENT IN COAL HYDROLIQUEFACTION Progress Report, 1 Sep 1979 - 30 Nov 1980

R R Beishline 25 Jul 1980 10 p refs

(Contract DE-AC02-79ER-10510)

(DOE/ER-10510-/T2) Avail NTIS HC A02/MF A01

The principal disproportionation products of 1,2-dihydronaphthalene (1,2-DHN) are naphthalene (Nap) and tetralin (Tet). Dimers of 1,2-DHN constitute 17% and 5% of the respective liquid phase (285 to 3150 C) and gas phase (385 to 4100 C) products. The Nap/Tet ratio is one in the presence of solvents but is > 1 and < 2 in their absence. Gas phase reaction kinetics indicate that 1,2-DHN disappears by simultaneous first and second order reactions. These results are consistent with a concerted second order disappearance of 1,2-DHN to produce equal amounts of Nap and Tet, accompanied by either carbonium ion or free radical side reactions that produce more Nap than Tet, together with 1,2-DHN dimers. Preliminary evaluation of the liquid phase kinetics suggest they follow a similar pattern. DOE

N81-22233# Exxon Research and Engineering Co., Linden, NJ Products Research Div

IMPROVING LOW TEMPERATURE PROPERTIES OF SYNTHETIC DIESEL FUELS DERIVED FROM OIL SHALE ALTERNATIVE FUELS UTILIZATION PROGRAM

J W Frankenfeld and William F Taylor Nov 1980 91 p refs

(Contract DE-AC01-79CS-50019)

(DOE/CS-50019/1) Avail NTIS HC A05/MF A01

The ability of additives to improve the cold flow properties of shale oil derived fuels boiling in the diesel fuel range was evaluated. Because a commercial shale oil industry did not exist to provide actual samples of finished fuels, a representative range of hydroprocessed shale oil fractions was prepared for use in the additive testing work. Crude oil shale was fractionated to give three liquids in the diesel fuel boiling range. The initial boiling point in each case was 3250F (1630C). The final boiling points were 6400F (3380C), 6700F (3540C) and 7000F (3710F). Each fraction was hydrotreated to three different severities (800, 1200 and 1500 psi total pressure) over a nickel molybdate on alumina catalyst at 710 to 7500F to afford 9 different model fuels. A variety of commercial and experimental additives were evaluated as cold flow improvers in the model fuels at treat levels of 0.04 to 0.4 wt percent. Both the standard pour point test and a more severe low temperature flow test were employed. DOE

04 FUELS AND OTHER SOURCES OF ENERGY

N81-22234# SRI International Corp Menlo Park, Calif
Materials Research Lab
SHIFT CONVERSION AND METHANATION IN COAL GASIFICATION BENCH-SCALE EVALUATION OF A SULFUR-RESISTANT CATALYST Final Report
B J Wood J G McCarty, D Sheridan, C M Ablow, and H Wise 24 Oct 1980 79 p refs
(Contract DE-AC21-78ET-11030)
(DOE/ET-11030/T1) Avail NTIS HC A05/MF A01

Results are presented which demonstrate that the Ir-promoted Ni/Al₂O₃ catalyst possesses several valuable and superior characteristics when used for catalytic methanation under typical industrial conditions. These properties include higher activity by a factor of > 2 than that of the unpromoted Ni/Al₂O₃ catalyst, enhanced resistance to deactivation by hydrogen sulfide during exposure to contaminated feedstock, as manifested by the prolonged high methanation activity and extended service lifetime, and high resistance to carbon fouling. DOE

N81-22236# Worcester Polytechnic Inst, Mass
KINETICS AND MECHANISMS OF CATALYTIC HYDROLIQUEFACTION AND HYDROGASIFICATION OF LIGNITE Quarterly Report, Apr - Jun 1980
A H Weiss Wilmer L Kranich, and Kemal Gueruez 25 Sep 1980 6 p
(Contract DE-AS01-77ET-10618)
(DOE/ET-10618/T1) Avail NTIS HC A02/MF A01

The basic chemical kinetics and mechanisms in catalytic hydrogenation of lignite suspended in a carrier oil in a continuous reactor operating at steady state were investigated. Emphasis was placed on the overall conversion rate and the elemental transformation from the raw materials into products under surface reaction controlling conditions. The reaction mechanisms of hydroliquefaction and hydrogasification of lignite were postulated based upon the results obtained. DOE

N81-22242# Bituminous Coal Research Inc, Monroeville Pa
TEST AND EVALUATE OF THE TRI-GAS LOW-Btu COAL GASIFICATION PROCESS Interim Report, Oct. 1979 - Sep 1980
Dec 1980 32 p
(Contract DE-AC21-78ET-10254)
(FE-10254-86, BCR-L-1149) Avail NTIS HC A03/MF A01

Work done to develop the tri-gas fluidized bed gasification process is described. A total of 11 tests were conducted seven with Rosebud seam coal (a noncaking coal) and four with Illinois No. 6 seam coal (a mildly caking coal). With one exception, the system was operated with the char and gas flows integrated in the process design mode. Smooth transfer of char and gas between reactors was accomplished. During the third test, all three reactor heaters failed. These were of the ribbon type and had been in service for about one year. The damage was such that the heaters had to be completely rebuilt. Because there was insufficient heater ribbon (Chromel A) to rebuild all of the heaters, only the heater for Stage 1 was repaired. Heaters of a different design were installed in Stages 2 and 3 using Globar type silicon carbide heating elements. The new design has the advantage of being simpler to install because of the reduced number of elements. New silicon carbide liners were cast for all three reactor vessels. Extensive cold model testing of new probes was conducted. Mathematical models of the tri-gas process were developed. DOE

N81-22243# Spectron Development Labs, Inc., Costa Mesa, Calif
EXPERIMENTAL INVESTIGATION OF SYN FUEL SPRAY CHARACTERISTICS AND COMBUSTION DYNAMICS Quarterly Technical Progress Repog, 1 Oct - 31 Dec 1980
Jan 1981 40 p refs
(Contract DE-AC22-80PC-30299)
(DOE/PC-30299/T2 SDL-81-2176-04Q) Avail NTIS HC A03/MF A01

The design and construction of the cold spray rig is reported. Air flow, fuel flow, and optical requirements were identified. These provided the basis for sizing the spray chamber, air flow ducting, blowers, fuel system, and general optical configurations. Detailed design of major systems was completed. In addition to the planned design and assembly work on the cold spray rig, preliminary laboratory experiments were conducted to help define the optical configuration for both the droplet sizing interferometry

measurements and the holographic imaging of the (injector) spray formation region. Monodispersed droplet generation techniques and oil burner designs for the generation of spray flames needed were also addressed. DOE

N81-22245# Union Carbide Corp Tonawanda NY
INDUSTRIAL OXYGEN PLANTS A TECHNOLOGY OVERVIEW FOR USERS OF COAL GASIFICATION-COMBINED-CYCLE SYSTEMS Final Report
R F Drnevich E J Ecelbarger, and J W Portzer Jan 1981 87 p Sponsored by Electric Power-Research Inst
(EPRI Proj 239-6)
(EPRI-AP-1674) Avail NTIS HC A05/MF A01

An overview of the technology associated with commercial oxygen production is presented with focus on the technical and economic aspects that may be important in gasification combined cycle power plant applications. The manual provides an excellent summary of the following topics: history of industrial oxygen production, oxygen plant process, oxygen plant equipment, process control, plant operation and reliability, economics of oxygen production, and environmental, safety, and health considerations. A major concern of many electric utilities is the safety of oxygen plants. The manual contains a detailed discussion of how identification and control of hydrocarbon vapors in air feed has resulted in modern industrial oxygen plants that are characterized by hazard free operation. DOE

N81-22246# Massachusetts Inst of Tech Cambridge Dept of Chemical Engineering
CROSSED REACTION NETWORKS IN THE CATALYTIC HYDRODENITROGENATION OF SYNTHETIC LIQUID FUELS
C N Satterfield and S Hsi 1980 10 p refs
(Contract DE-AC22-80PC-30075)
(DOE/PC-30075/2 QR-2) Avail NTIS HC A02/MF A01

The gas feed control system, liquid feed system, the trickle bed reactor, a gas liquid separator and sampling system and automatic safety features were constructed. The gas chromatograph, Perkin Elmer Sigma 1B was received and tested. The theoretical background for design of the laboratory trickle bed reactor is given in detail. DOE

N81-22247# Institute of Gas Technology Chicago, Ill
SYNTHETIC FUELS FROM US OIL SHALES A TECHNICAL AND ECONOMIC VERIFICATION OF THE HYTORT PROCESS Quarterly Report, 1 Apr - 30 Jun 1980
Nov 1980 96 p refs
(Contract DE-AC01-79ET-14102)
(DOE/ET-14102/1) Avail NTIS HC A05/MF A01

Thermobalance tests were conducted on samples of shale from each large multitor sample prior to large scale tests and these test results were fit with specific kinetic expressions. Approximately 60 percent of the instrumentation for the laboratory scale reactor was received. Fabrication of the reactor, feed hopper and residue receiver is about 95 percent complete. Two successful moving bed tests were conducted in the bench scale reactor. A large 50 ton sample of the Lower Huron member of the Ohio Shale was mined and readied for shipment. Modification of the bench scale steam oxygen unit was completed. Spent shale from PDU tests was prepared for use in these tests. A set of five screening runs on New Albany shale oil and a set of four screening runs on Sunbury shale oil were conducted. DOE

N81-22248# Arizona State Univ Tempe
CONVERSION OF CELLULOSIC WASTES TO LIQUID HYDROCARBON FUELS Progress Report, Jan - Feb 1981
James L Kuester 1981 5 p refs Sponsored by DOE
(CQO-2982-66) Avail NTIS HC A02/MF A01

The following materials were processed through gasification: sugarcane bagasse, smooth sumac, coralberry, wild bergamot, pokeweed, cornstarch, Portuguese oak cork, and hog fuel. A data summary is given. The high H₂/CO ratio at low temperature for pokeweed is of significance. Also the high olefin content of Portuguese oak cork (commercial cork) is of major interest. The most promising feedstock to date with regard to synthesis gas composition was guayule cork. A comparison of data for the two cork materials is given. A detailed breakdown for corn starch is given revealing an exceptionally high methane content (35.50 mole percent). DOE

**N81-22440# Utah State Univ, Logan
HYDROLOGIC ASPECTS OF WATER HARVESTING ON
PROCESSED OIL SHALE, A SALINE MEDIUM
Ph D Thesis**

Ali Malek 1981 219 p
Avail Univ Microfilms Order No 8104111

Hydrologic characteristics of processed shale are discussed with the possibility of applying water harvesting techniques to supply additional water to supplement natural precipitation for establishing plants on a spent shale pile for rehabilitation. Four types of soil stabilizing materials were tested for their efficiency to harvest water. Natural precipitation of the area was simulated by applying a total of 13.4 cm of artificial rain in four distinct times using a rainfall simulator. For all treatments, water harvesting efficiency increased during the experiment despite the damaging and disintegration of the materials which would generally act to increase the water percolation and reduce runoff. Styrene butadiene generally produced the highest amount of harvested water of runoff followed by paraffin treated plots. Plots treated with mulch produced the least amount of runoff.

Dissert Abstr

**N81-22456# Colorado School of Mines, Golden
SAMPLING DESIGNS FOR GEOCHEMICAL BASELINE
STUDIES IN THE COLORADO OIL SHALE REGION: A
MANUAL FOR PRACTICAL APPLICATION**

Ronald W Klusman, Charles D Ringrose, Robert J Candito, Bruce Zuccaro, David W Rutherford, and Walter E Dean (U S Geological Survey) Jun 1980 193 p refs
(Contract DE-AC02-79EV-10298)
(DOE/EV-10298/2) Avail NTIS HC A09/MF A01

A rationale for sampling designs, and results of geochemical baseline studies in the Colorado portion of the oil-shale region are presented. The manual is divided into five major parts. The first is a suggested sampling protocol presented in outline form for guiding baseline studies in this area. The second section is background information on the physical features of the area of study, trace elements of significance occurring in oil shale, and the sample media used in these studies. The third section is concerned primarily with sampling design and its application to the geochemical studies of the oil shale region. The last sections in the form of appendices, provide actual data and illustrate in a systematic manner the calculations performed to obtain the various summary data. The geochemistry of trace elements and the parameters of importance influencing their behavior in natural systems are also discussed.

DOE

**N81-22459# Sandia Labs, Livermore, Calif
PROJECT DEEP STEAM Quarterly Report, 1 Apr. - 1 Jun
1980**

R L Fox, R G Clay, A B Donaldson, S W Eisenhower, D R Johnson, W D Lyle, and A J Mulac Jan 1981 45 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-2631) Avail NTIS HC A03/MF A01

The technology required to economically produce heavy oil from deep reservoirs was studied including thermally efficient delivery systems and downhole steam generation systems. The initial field testing of a downhole steam generator design which was operated on the surface was completed. Design and fabrication of downhole generation systems for the next phase of testing are under development. Full scale simulation tests of thermally efficient delivery strings at the Tacoma, Washington test facility have continued. A comparison of two designs for calcium silicate insulated strings has demonstrated significant reduction in casing temperature can be achieved by changes in joint design.

DOE

**N81-22504# Ames Lab, Iowa
ADVANCED RESEARCH AND TECHNOLOGY DIRECT
UTILIZATION RECOVERY OF MINERALS FROM COAL FLY
ASH FOSSIL ENERGY PROGRAM Technical Progress
Report, 1 Jul - 30 Sep, 1980**

G Burnett, M J Murtha, and D J Adelman Dec 1980 110 p refs
(Contract W-7405-eng-82)
(IS-4760) Avail NTIS HC A06/MF A01

Methods for utilizing coal fly ash through processes for the extraction of alumina and titania, and for the separation and use of an iron-rich fraction are described. Research of the HiChlor

process for the extraction of alumina and titania by high temperature chlorination of a fly ash reductant mixture is described. An engineering cost evaluation is presented for a centralized HiChlor processing facility to process the fly ash of several large coal fueled power stations. Investigations for a high temperature lime soda process for extraction of alumina from fly ash included the use of several types of quarry limestones and waste materials to replace the limestone and/or soda ash.

DOE

**N81-22508# Ames Lab, Iowa
FOSSIL ENERGY Annual Report, 1 Oct 1979 - 30 Sep
1980**

Dec 1980 176 p refs
(Contract W-7405-eng-82)
(IS-4757) Avail NTIS HC A09/MF A01

Of particular interest are the development of leaching procedures in the Ames wet oxidation process for desulfurizing coal and the cleaning and recovery of coal fines by flotation and oil agglomeration. Organic sulfur compounds in coal and the behavior of specific organic sulfur compounds chosen as structural models for the sulfur compounds in coal were studied.

DOE

**N81-22525# Edgerton, Germeshausen and Grier, Inc., Idaho
Falls, Idaho**

**POTENTIAL INDUSTRIAL APPLICATIONS FOR DIRECT
CONTACT WASTE HEAT RECUPERATOR SYSTEMS Final
Report**

T T Semler Feb 1981 216 p refs
(Contract DE-AC07-76ID-01570)
(EEG-CS-5328) Avail NTIS HC A10/MF A01

Four potential applications were chosen for economic analysis. They are: stack gas from diesel electric generation boiler stack gas waste heat stream from the hydraulic cement dry process dryer, and stack gas from the fire polishing of glass. The waste heat streams studied ranged from 175 to 7500 F. A physical analogue of the direct contact waste heat recuperator system was devised and used for costing purposes. Payback calculations were performed for these applications. Only the stack gas from the fire polishing of glass failed to show significant economic promise. A waste heat stream regime of greater than 10,000 cfm and between 400 and 7500 F was identified as most economically promising for direct contact waste heat recuperation and hot process water delivery.

DOE

**N81-22543# California Univ, Berkeley, Lawrence Berkeley
Lab, Engineering and Technical Services Div
GEOTHERMAL RESOURCE AREAS DATABASE FOR
MONITORING THE PROGRESS OF DEVELOPMENT IN THE
UNITED STATES**

J Dennis Lawrence, Susan R Lepman, Keith N Leung, and Sidney L Phillips Jan 1981 73 p refs
(Contract W-7405-eng-48)
(LBL-10418) Avail NTIS HC A04/MF A01

The Geothermal Resource Areas Database (GRAD) and associated data system provide broad coverage of information on the development of geothermal resources in the United States. The system is designed to serve the information requirements of the National Progress Monitoring System. GRAD covers development from the initial exploratory phase through plant construction and operation. Emphasis is on actual facts or events rather than projections and scenarios. The selection and organization of data are based on a model of geothermal development. Subjects in GRAD include names and addresses, leases, area descriptions, geothermal wells, power plants, direct use facilities, and environmental and regulatory aspects of development. Data collected in the various subject areas are critically evaluated, and then entered into an on-line interactive computer system. The system is publicly available for retrieval and use. The background of the project, conceptual development, software development, and data collection are described as well as the structure of the database.

DOE

**N81-22558# Battelle Pacific Northwest Labs, Richland, Wash
INVESTIGATIONS ON CATALYZED STEAM GASIFICATION
OF BIOMASS APPENDIX A: FEASIBILITY STUDY OF
METHANE PRODUCTION VIA CATALYTIC GASIFICATION
OF 2000 TONS OF WOOD PER DAY**

L K Mudge, S L Weber, D H Michell, L J Sealock, Jr, and

04 FUELS AND OTHER SOURCES OF ENERGY

R J Robertus Jan 1981 135 p Prepared in cooperation with McKee (Davy) Corp Cleveland (Contract DE-AC06-76RL-01830) (PNL-3695-App-A) Avail NTIS HC A07/MF A01

The plant is designed to process 2000 tons per day of dry wood to SNG Plant production is 21.6 MM scfd of SNG with a HHV of 956 Btu per scf All process and support facilities necessary to convert wood to SNG are included The plant location is Newport Oregon The capital cost for the plant is \$95 115,000 September, 1980 basis Gas production costs which allow for return on capital were calculated for various wood prices for both utility and private investor financing DOE

N81-22577# Du Pont de Nemours (E I) and Co, Wilmington, Del
SYNFUEL PROGRAM ANALYSIS VOLUME 2: VENVAL USERS MANUAL
J B Muddiman and J W Whelan Jul 1980 145 p refs 2 Vol

(Contract DE-AC09-76SR-00001)
(DOE/RA-00001/T5-Vol-2) Avail NTIS HC A07/MF A01

This volume is intended for program analysts and is a users manual for the VENVAL model It contains specific explanations as to input data requirements and programming procedures for the use of this model VENVAL is a generalized computer program to aid in evaluation of prospective private sector production ventures The program can project interrelated values of installed capacity, production, sales revenue, operating costs, depreciation, investment, dent earnings, taxes return on investment, depletion, and cash flow measures It can also compute related public sector and other external costs and revenues if unit costs are furnished DOE

N81-22624 Utah Univ, Salt Lake City
THERMAL STUDIES IN A GEOTHERMAL AREA
Ph D Thesis

Wesley Raphael Wilson 1980 156 p
Avail Univ Microfilms Order No 8106881

Interpretation of heat flow data is divided into three parts (1) a field study at Roosevelt Hot Springs Utah which demonstrates how the heat flow map is developed and how it can be enhanced to determine deep reservoir geometry, (2) a technique for interpreting a heat flow profile traversing a fault where fluids are constrained to flow along the fault plane, and (3) a method for correcting heat flow measurements made on an arbitrary surface to a constant elevation datum plane Temperature profiles and heat flow values were determined for 53 drill holes within the Roosevelt Hot Springs KGRA (Known Geothermal Resource Area) Utah The temperature profiles can be classified in three spatially consistent patterns on the basis of their thermal gradient value These patterns delineate hydrologic recharge, active convection, and discharge regions respectively Dissert. Abstr

N81-22625 Wisconsin Univ - Madison
GEOPHYSICAL-GEOLOGICAL EXPLORATION FOR OFF-SHORE SAND AND GRAVEL, WESTERN LAKE MICHIGAN
Ph D. Thesis

Carol Jean Jiglotti Waikie 1980 188 p
Avail Univ Microfilms Order No 8028215

Assessment of sand and gravel resources in western Lake Michigan is a contribution to remote sensing methodology for efficiently locating and estimating the volume of subaqueous deposits Four inexpensive and rapid geophysical profiling methods were tried in order to determine continuously the variability of sediments along profiles and at depth high resolution acoustic profiling resistivity profiling seismic refraction, and resistivity sounding The latter two methods were modified to approach continuous data acquisition along profiles Based upon the geophysical data samples were taken at representative locations to provide verification of sediment type and an indication of the quality of deposits found Three sites examined 1977-78, were selected because they were adjacent to known onshore deposits, were near high-use urban centers and in one case, offshore sands had previously been sampled surficially and cores

Dissert. Abstr

N81-22647# Los Alamos Scientific Lab N Mex
GEOLOGIC MAP OF THE SULPHUR SPRINGS AREA, VALLES CALDERA GEOTHERMAL SYSTEM, NEW MEXICO

Fraser E Goff and Jamie N Gardner Dec 1980 36 p refs
Sponsored by DOE
(LA-8634-MAP) Avail NTIS HC A03/MF A01

The geologic and tectonic setting and geology of Sulphur Springs Area are described Geologic faults, sheared or brecciated rock volcanic vents, geothermal wells hydrothermal alteration springs thermal springs fumaroles, and geologic deposits are indicated on the map DOE

N81-22648# Los Alamos Scientific Lab N Mex
GEOLOGIC FRAMEWORK AND HOT DRY ROCK GEOTHERMAL POTENTIAL OF THE CASTLE DOME AREA, YUMA COUNTY, ARIZONA

J T Gutmann (Wesleyan Univ) Feb 1981 24 p refs
(Contract W-7405-eng-36)

(LA-8723-HDR) Avail NTIS HC A02/MF A01

The Castle Dome Mountains and surrounding ranges constitute a voluminous pile of silicic volcanic rocks within the Basin and Range province of southwestern Arizona Previously reported as Cretaceous and Quaternary in age these volcanics all are of late Oligocene to early Miocene age as indicated by five new K-Ar dates Reconnaissance field studies indicate that the volcanic section locally has undergone large rotations that contrast with the usual structural style of the Basin and Range and resemble the thin skinned rotational tectonics documented for earlier, mid Tertiary extensional deformation in ranges to the north and northeast Significant geothermal potential of the Castle Dome area is suggested by a shallow depth to the Curie isotherm and by the apparent presence of a good electrical conductor at anomalously shallow depth in the crust Warm wells exist in the area as well as a geothermal gradient of about 700 C/km in a dry well near the center of the gravity low radiogenic heat production in the silicic batholith inferred above constitutes a reasonable candidate for a shallow regional heat source DOE

N81-22650# West Virginia Univ, Morgantown Dept of Geology and Geography

ANALYSIS OF THE STRUCTURAL PARAMETERS THAT INFLUENCE GAS PRODUCTION FROM THE DEVONIAN SHALE VOLUME 2 DATA REPOSITORY AND REPORTS PUBLISHED DURING FISCAL YEAR 1979 - 1980, REGIONAL STRUCTURE, SURFACE STRUCTURE, SURFACE FRACTURES AND HYDROLOGY Annual Progress Report, 1979 - 1980

J Negus-DeWys Jeanette M Dixon Mark A Evans Kevin D Lee James E Ruotsala Thomas H Wilson, and Richard T Williams Oct 1980 616 p refs

(Contracts DE-AC21-76ET-12138 DE-AC21-76MC-05194)
(DOE/ET-12138/T1-Vol-2) Avail NTIS HC A99/MF A01

Appendices giving regional structure data surface structure data, surface fracture data and hydrology data are presented The fracture data cover oriented Devonian shale cores from West Virginia Ohio, Virginia, Pennsylvania and Kentucky The subsurface structure of the eastern Kentucky gas field is also covered DOE

N81-22651# West Virginia Univ Morgantown Dept of Geology and Geography

ANALYSIS OF THE STRUCTURAL PARAMETERS THAT INFLUENCE GAS PRODUCTION FROM THE DEVONIAN SHALE VOLUME 3 DATA REPOSITORY AND REPORTS Annual Progress Report, 1979 - 1980

J Negus-DeWys Oct 1980 597 p refs Presented at 26th Intern Geol Congr Paris Jul 1980 Submitted for publication (Contracts DE-AC21-76ET-12138 DE-AC21-76MC-05194)
(DOE/ET-12138/T1-Vol-3) Avail NTIS HC A25/MF A01

Inorganic geochemistry studies of the Eastern Kentucky Gas Field lithology studies of upper Devonian well cuttings in the Eastern Kentucky Gas Field and possible effects of plate tectonics on the Appalachian Devonian black shale production in eastern Kentucky are examined Preliminary depositional model for upper Devonian Huron age organic black shale in the Eastern Kentucky Gas Field the anatomy of a large Devonian black shale gas field the Cottageville (Mount Alto) Gas Field Jackson County West Virginia a case study of Devonian shale gas production the Eastern Kentucky Gas Field a geological study of the relationships of Ohio shale gas occurrences to structure stratigraphy lithology, and inorganic geochemical parameters and a statistical analysis of geochemical data for the Eastern Kentucky Gas Field are also included DOE

N81-22664# United Industries Corp. Bellevue Wash
WIND FIELD PREDICTIONS FOR THE COLUMBIA GORGE AND THE GOODNOE HILLS WIND TURBINE SITE
 Scott D Veenhuizen and Jung-Tai Lin Aug 1980 104 p refs
 (Contract DE-AC79-80BP-18979)
 (DOE/BP-18979/T1 UIC-8003) Avail NTIS
 HC A06/MF A01

Numerical estimates of the long term seasonal mean wind speeds, wind directions and available wind power density were conducted for comparison with the results of field wind measurements obtained for the Columbia Gorge region along the Oregon Washington border. The numerical technique was used as a generalized wind prospecting tool to provide the link between regional assessments and on site biological or geomorphological indicators of mean wind speeds and available wind energy. The wind flow model used is a two dimensional model based upon simplified hydrodynamical equations describing the fluid and thermodynamic motion of the atmosphere. DOE

N81-22665# Battelle Pacific Northwest Labs Richland Wash
METEOROLOGICAL ASPECTS OF SITING LARGE WIND TURBINES
 T R Hiestler and W T Pennell Jan 1981 512 p refs
 (Contract DE-AC06-76RL-01830)
 (PNL-2522) Avail NTIS HC A22/MF A01

The elements of a siting strategy that will identify the most favorable wind energy sites in a region and that will provide sufficient wind data to make responsible economic evaluations of the site wind resource possible are outlined. Siting techniques that were studied in the Department of Energy (DOE) Wind Energy Program are summarized. A major goal is to educate utility technical personnel, engineering consultants and meteorological consultants (who may have not yet undertaken wind energy consulting) on meteorological phenomena relevant to wind turbine siting in order to enhance dialogues between these groups. DOE

N81-22667# Flowpower Inc. Huntington Station NY
HIGH YIELD WIND ENERGY RESOURCES IN NEW YORK STATE. Final Report, May 1979 - May 1980
 P M Sforza M J Smorto and B Bailey Jun 1980 177 p refs
 (PB81-142754 NYSERDA-80-11) Avail NTIS
 HC A09/MF A01 CSCL 04A

A wind energy inventory for New York state is based on data collected at numerous meteorological stations and anemometers, throughout the state. There are a number of regions in the state which could possibly host one or more large (greater than 100kW) wind turbine generators. An extensive analysis of life cycle electrical energy production costs is given for various wind turbine generators which are now being manufactured or which will be manufactured in the near future. GRA

N81-22859# Los Alamos Scientific Lab N Mex
GENERAL-PURPOSE HEAT SOURCE PROJECT AND SPACE NUCLEAR SAFETY AND FUELS PROGRAM. Progress Report

W J Maraman comp Sep 1980 19 p
 (LA-8714-PR) Avail NTIS HC A02/MF A01

Results from investigations relating to the use of (238) PuO₂ in radioisotopic power systems are reported. The development of general purpose heat sources and support systems are addressed. MG

N81-22860# Los Alamos Scientific Lab N Mex
GENERAL-PURPOSE HEAT SOURCE PROJECT AND SPACE NUCLEAR SAFETY AND FUELS PROGRAM. Progress Report

W J Maraman comp Aug 1980 31 p ref
 (LA 8713-PR) Avail NTIS HC A03/MF A01

Studies related to the use of (238)PuO₂ in radioisotopic power systems are detailed. The two programs involved are general purpose heat source development and space nuclear safety and fuels. SF

N81-22958# Notre Dame Univ, Ind Dept of Metallurgical Engineering and Materials Science
MICROSTRUCTURAL EFFECTS IN ABRASIVE WEAR
 Quarterly Progress Report, 1 Sep - 1 Dec 1980
 N F Fiore T H Kosel, C Rao V Desai, and H R Shetty

3 Feb 1981 65 p refs
 (Contract DE-AS02-77ET-10460)
 (DOE/ET-10460/15) Avail NTIS HC A04/MF A01

Quantitative relationships between microstructure and wear resistance of highly alloyed materials were examined. High-Cr white irons and experimental Co-base and Ni-base powder metallurgy (PM) alloys now used or potentially to be used in coal mining handling, and gasification were included. The specific types of wear studied were low-stress abrasion and gouging wear encountered in mining coal conversion, and transfer applications. Abrasion in multiphase alloys was also studied. DOE

N81-23215# Acurex Corp, Mountain View Calif Energy and Environmental Div
CATALYTIC COMBUSTION OF COAL-DERIVED LIQUID FUELS. Final Report
 E K Chu G C Snow, and H Tong Jan 1981 140 p refs
 (EPRI Proj 989-3) Avail NTIS HC A07/MF A01
 (EPRI-AP-1666)

The feasibility of catalytically burning currently available coal derived liquids was evaluated. The combustion characteristics of coal derived liquids in catalytic reactors were determined and possible long term poisoning of the catalyst by the coal derived liquid was evaluated. Tests were conducted with three state of the art catalytic materials and three fuels. No 2 diesel for baseline data and H Coal and SRC II coal derived liquids. The results show that coal derived liquids can be burned catalytically but the catalysts were prone to poisoning or deactivation. However the causes for catalyst deactivation were not clearly identified. DOE

N81-23217# Bureau of Mines Albany Oreg
EFFECTS OF ADDITIVES ON METHANATION ACTIVITY OF RANEY NICKEL CATALYSTS
 J H Russell, Laurance L Oden and Jack L Henry 1980 25 p refs. Sponsored in part by DOE
 (BM-RI-8487) Avail NTIS HC A02/MF A01

The Bureau of Mines has attempted to increase the activity of nickel catalysts for converting synthesis gas, derived from coal to a substitute natural gas. The effects of low level additions of B, Ca, Ce, Co, Mn, Mo, Pd, Re, Ti, Y, Zn, and Zr on the methanation activity of Raney nickel are described. The methanation rate are 3200 C and the resistance to poisoning by 2 ppm H₂S were used to compare catalysts. The effects of the additions were small and the experimental variances were large necessitating the use of statistical methods to identify significant effects. The Co, Ti, Y and Zn improved the resistance to H₂S poisoning but only Co improved the methanation rate. In some individual catalysts containing Ca, Mo, or Mn both the methanation rate and resistance to H₂S poisoning were improved. DOE

N81-23219# Physical Sciences Inc Woburn Mass
PULVERIZED FUEL COMBUSTION MODELING AND SCALEUP METHODOLOGIES. Quarterly Report, 19 Sep - 30 Dec 1980

Paul F Lewis Thomas L Wolf and Alan Gelb Jan 1981 23 p refs
 (Contract DE-AC22-80PC-30294)
 (DOE/PC-30294/1, PSI-TR-253, QR-1) Avail NTIS
 HC A02/MF A01

The effort to develop an understanding of the stability and carbon carryover characteristics of pulverized fuel combustors is discussed. This is to be accomplished by improving and extending a model developed for entrained flow coal gasifier analysis by including a better description of the finite rate coal pyrolysis, pyrolysis product chemistry, char reactions, particle-particle interactions, radiative transport and recirculation/mixing. The data to be analyzed with the model includes data from simple (cylindrical symmetry) geometry combustors with premixed and mixing reactants, swirl and recirculation. The analysis of these data with the model should lead to an understanding of the effects of fuel type, swirl, recirculation, O/F ratio and mixing rate on the location (stability) of the flame and the carbon carryover from the combustor. DOE

N81-23234# Bureau of Mines, Pittsburgh Pa
CONTROLLED BURNOUT OF WASTED COAL ON ABANDONED COAL MINE LANDS

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Robert F Chaiken 1980 29 p refs
(PB81-148231 BM-RI-8478) Avail NTIS HC A03/MF A01
CSCL 13B

An approach to eliminating environmental and public safety hazards associated with fires in abandoned coal mines and waste banks involves the use of in situ combustion technology developed by the Federal Bureau of Mines to accelerate the burning of the wasted coals in place. This technology is used under exhaust ventilation control conditions that allow for total management of the hot gases produced. Combustion stoichiometries are optimized to minimize unburnt combustibles and to maximize the heat content of the gas products which are exhausted at one or more fan locations. When necessary, scrubber systems are employed to remove air pollutants such as sulfur dioxides. heat utilization systems are also employed to offset operational costs
GRA

N81-23263# Metal Properties Council, Inc. New York
PROGRAM TO DISCOVER MATERIALS SUITABLE FOR SERVICE UNDER HOSTILE CONDITIONS OBTAINING IN EQUIPMENT FOR THE GASIFICATION OF COAL AND OTHER SOLID FUELS Quarterly Progress Report, 1 Jul - 30 Sep, 1980

A O Schaefer, ed Sep 1980 149 p Prepared for Union Carbide Corp and Gas Research Inst
(Contracts DE-AC05-76ET-10670, EX-76-C-01-1784)
(FE-1784-69) Avail NTIS HC A07/MF A01

The progress on a program designed to screen materials for use in coal gasification plants with respect to the various unique corrosive environments obtaining therein and to provide useful corrosion data as well as reliable information on other properties needed for the design, construction, and operation of such plants is reported. A summary of achievements is followed by detailed results of corrosion testing of selected materials
DOE

N81-23254# International Nickel Co., Inc. Suffern, N Y
Research and Development Center
WELD OVERLAYING FOR CORROSION RESISTANCE IN COAL-GASIFICATION ATMOSPHERES Final Report, 15 Aug 1977 - 15 Aug 1979

Edward P Sadowski 1979 268 p refs
(Contracts DE-AC01-77ET-10496 EF-77-C-01-2621)
(FE-2621-15) Avail NTIS HC A12/MF A01

Two nickel-base filler metals designed to deposit high Cr and Cr-Al contents were used to surface Types 303L and 310 stainless steel (SS) and INCOLOY alloy 800H. Single and double layers of high chromium filler were deposited successfully using three weld processes: submerged-arc, gas metal-arc, and gas tungsten-arc with a hot wire addition. The compositions of the deposited overlays were affected by the compositions of the filler metal and substrate, the percentage dilution, the percentage recovery of elements across the arc, and the composition of the flux used with the submerged arc welding process. All surfaced substrates had better corrosion resistance than the unprotected substrates when exposed for 1000 hours in a coal gasification atmosphere (CGA) at 982°C (1800°F). The different filler metals, substrates or welding processes evaluated did not affect the as-welded room temperature tensile properties of composite specimens of overlay and substrate
DOE

N81-23265# California Univ., Berkeley Materials and Molecular Research Div

MECHANISMS OF EROSION/CORROSION OF METALS AND THEIR OXIDE SCALES

A Levy, R Bellman, Jr., and J Maasberg Dec 1980 28 p refs Submitted for publication
(Contract W-7405-eng-48)
(LBL-12023) Avail NTIS HC A03/MF A01

The basic mechanisms of degradation that occur when a small particle impact on a bare metal surface or on one that contains a thin oxide scale were examined in order to provide the basis for selecting operating conditions and developing more resistant materials for coal gasifiers. The work to date indicates that significant differences in erosion behavior occurs as the result of different elevated temperature corrosion conditions forming different scale and interface compositions and morphologies. Generally the differences are relatively minor. Yet under conditions of combined erosion corrosion, these differences could become important. Even though the scales were thin and on ductile matrices their erosion behavior variation with impingement

angle was that of a brittle rather than a ductile material. The use of erosion tests to study the adherence of various scales has some merit; however, interpretation of some of the smaller differences could be difficult
DOE

N81-23257# Colorado State Univ. Fort Collins Dept of Chemistry

METALLIC SPECIES DERIVED FROM FLUIDIZED BED COAL COMBUSTION Final Report

David F S Natusch and David R Taylor 1980 110 p refs
(Contracts DE-AS21-77MC-08196 EY-77-S-21-8196)
(DOE/MC-08196/T1) Avail NTIS HC A06/MF A01

Samples of fly ash generated by the combustion of Montana Rosebud coal in an experimental 18 inch fluidized bed combustor were collected. The use of a heated cascade impactor permitted collection of size fractionated material that avoided condensation of volatile gases on the particles. Elemental concentration trends were determined as a function of size and temperature and the results compared to published reports for conventional power plants. The behavior of trace metals appears to be substantially different in the two systems due to lower operating temperatures and the addition of limestone to the fluidized bed. Corrosion of the impactor plates was observed at the highest temperature and lowest limestone feed rate sampled during the study. Data from the elemental concentration and leaching studies suggest that corrosion is most likely due to reactions involving sodium sulfate. However, it is concluded that corrosion is less of a potential problem in fluidized bed systems than in conventional coal fired systems
DOE

N81-23304# Naval Research Lab., Washington D C Environmental Biology Branch

MICROBIAL DETERIORATION OF MARINE DIESEL FUEL FROM OIL SHALE Final Report

M E May and R A Neihof 9 Apr 1981 17 p refs
(AD-A097674 NRL-MR-4489) HC A02/MF A01 CSCL 06/13

Recurring problems with conventional ship fuels caused by microorganisms have prompted an evaluation of the susceptibility of a recently produced synthetic diesel fuel from oil shale to microbial contamination. The growth of typical microbial contaminants of hydrocarbon fuels has been determined over a four month period in two-phase systems consisting of fresh and sea water media overlaid with fuel. Anaerobic sulfate-reducing bacteria and a yeast (*Candida* sp.) grew as well in the synthetic fuel as in fuel derived from petroleum. Growth of certain strains of the fungus *Cladosporium resinae*, was initially delayed in the synthetic diesel fuel but after 8-13 weeks the growth was generally comparable to that in petroleum-derived fuel. This finding indicated that *C. resinae* may require time for adaptation to constituents in the oil shale fuel. Ultimately however it appears that the synthetic diesel fuel is likely to be as susceptible to microbial contamination as conventional diesel fuel has been. Experience acquired with available synthetic fuels shows that their ability to support growth of microbial contaminants varies widely depending on both the source of crude oil and the refining processes used
Author (GRA)

N81-23306# Union Oil Co. of California Brea Science and Technology Div

ETHANOL FUEL MODIFICATION FOR HIGHWAY VEHICLE USE Final Report

Jan 1980 220 p refs
(Contract EY-76-C-04-3683)
(ALO-3683-T1) Avail NTIS HC A10/MF A01

A number of problems that might occur if ethanol were used as a blending stock or replacement for gasoline in present cars are identified and characterized as to the probability of occurrence. The severity of their consequences is contrasted to those found with methanol in a previous contract study. Possibilities for correcting several problems are reported. Some problems are responsive to fuel modifications but others require or are better dealt with by modification of vehicles and the bulk fuel distribution system. In general problems with ethanol in blends with gasoline were found to be less severe than those with methanol. Phase separation on exposure to water appears to be the major problem with ethanol/gasoline blends. Another potentially serious problem with blends is the illicit recovery of ethanol for beverage usage, or bootlegging which might be discouraged by the use of select denaturants. Ethanol blends

have a somewhat greater tendency to vapor lock than base gasoline but less than methanol blends Gasoline engines would require modification to operate on fuels consisting mostly of ethanol
DOE

N81-23308# Combustion Engineering, Inc., Windsor, Conn
Power Systems Group

INDUSTRIAL APPLICATION OF C-E COAL-GASIFICATION PROCESS Final Report, Jan. 1979 - Aug 1980

K Atabay, M Baldassari and P R Thibeault Jan 1981
224 p refs

(Contract DE-AC01-76ET-10204)

(FE-1545-86) Avail NTIS HC A10/MF A01

Plant designs were developed and costs estimated for each of four cases to determine the potential of a clean fuel gas produced from a C-E gasifier as a cost effective substitute for present energy sources or feedstocks The gasification potential for industry was determined by reviewing the literature for energy demand and how energy is used It is estimated that the potential for coal gasification in industry is about 5×10 to the 15th power Btu per year This potential represents about 500 gasification plants at an average capacity of 30×10 to the 9th power Btu per day Those industries which were identified as having the largest potential are the petroleum, chemical, steel, and paper industries with a combined estimated potential of 4.5×10 to the 15th power Btu/year Other industries with a sizable potential are the stone, glass, food, and metal mining industries
DOE

N81-23309# TRW Inc., McLean, Va Energy Engineering Div

COALBED METHANE PRODUCTION CASE HISTORIES

Feb 1981 38 p

(Contract DE-AC21-78MC-08089)

(DOE/METC-08089/115) Avail NTIS HC A03/MF A01

A brief description of wells that are presently producing gas from coal or coal bearing rocks is given Data from three gob gas production areas in Illinois an in-mine horizontal borehole degasification, and eleven vertical boreholes are presented Production charts and electric logs of the producing zones are included for some of the wells Additional information on dry gas production from the San Juan Basin, Colorado/New Mexico and the Greater Green River Coal Region, Colorado/Wyoming is also included
DOE

N81-23310# Rockwell International Corp Canoga Park, Calif
Energy Systems Group

MOLTEN SALT COAL GASIFICATION PROCESS DEVELOPMENT UNIT, PHASE 2 Quarterly Technical Progress Report, Jul - Sep 1980

M H Slater 20 Oct 1980 60 p

(Contract DE-AC03-77ET-10296)

(DOE/ET-10296/70 QTPR-1) Avail NTIS HC A04/MF A01

The feasibility of the molten salt coal gasification (MSCG) process for producing low Btu gas is demonstrated A process development unit (PDU) was built for converting 1 ton of coal per hour to a nonpolluting low Btu fuel (about 150 Btu/scf) at about 1800 F and up to 20 atm pressure The system was equipped for removing ash regenerating sodium carbonate and disposing of sulfur from the coal
RCT

N81-23311# Chevron Research Co., Richmond, Calif
REFINING AND UPGRADING OF SYNTHETIC FUELS FROM COAL AND OILSHALES BY ADVANCED CATALYTIC PROCESSES Quarterly Report, Jul. - Sep. 1980

R F Sullivan, D J Orear, and H. A. Frumkin Oct 1980
29 p

(Contracts DE-AC22-76ET-10532 EF-76-C-01-2315)

(FE-2315-58) Avail NTIS HC A03/MF A01

This quarterly report includes design improvements for the refining of SRC-II syncrude hydrocracking experimental results on Wyodak H-Coal syncrude, and estimates of the potential yield of benzene toluene and eliminated from the proposed SRC-II refining scheme This reduces the investment by \$50 MM and reduces the refining cost by \$0.50/bbl The experimental program on H-Coal syncrudes is complete Updated analyses on the last task in this program, extinction recycle hydrocracking, are included The potential yield of benzene toluene and xylene from Wyodak

H-Coal, Illinois H-Coal, and SRC-II syncrudes is nearly 50% Slight differences between the yield from the three syncrudes can be accounted for by differences in the properties of the syncrudes
DOE

N81-23313# Ames Lab Iowa Earth Sciences Dept
CHANGES OCCURRING IN COAL DURING IN SITU GASIFICATION M S Thesis

Gregory L. Thompson Feb 1981 128 p refs

(Contract W-7405-eng-82)

(IS-T-950) Avail NTIS HC A07/MF A01

Simulated in situ gasification experiments are discussed which combusted lignite and bituminous coals under nearly identical conditions Several standard coal and coke analysis techniques were used to chemically, physically and petrographically characterize the coal and the residues left after its gasification experiments Additional comparisons of these residues to carbonized coal were made largely because of their visual similarities These comparisons provide added insight into the changes the in situ gasification residues undergo
DOE

N81-23314# Institute of Gas Technology, Chicago, Ill
RESEARCH AND DEVELOPMENT OF RAPID HYDROGENATION FOR COAL CONVERSION TO SYNTHETIC MOTOR FUELS (RISER CRACKING OF COAL) Final Report, 1 Apr 1976 - 30 Sep 1980

D A Duncan Justin L Beeson and R Donald Oberle Feb 1981 208 p refs

(Contracts DE-AC21-76ET-10520 EX-76-C-01-2307)

(DOE/ET-10520/1) Avail NTIS HC A10/MF A01

The objective of the program described was to develop a noncatalytic process for the hydrolysis of lignite and coal to produce high octane blending gasoline constituents, methane ethane and carbon oxides The process would operate in a balanced plant mode using spent char to generate process hydrogen by steam oxygen gasification The technical program included the construction and operating of a bench scale unit the design construction and operation of a process development unit (PDU), and a final technical and economic assessment of the process, called Riser Cracking of Coal In the bench scale unit program, 143 runs were made investigating the effects of pressure temperature, heating rate, residence time, and particle size, processing North Dakota lignite in hydrogen Some runs were made in which the hydrogen was preheated to pyrolysis temperatures prior to contact with the coal and also in which steam was substituted for half of the hydrogen Depth of carbon conversion was found to be influenced by hydrogen pressure hydrogen to coal ratio, and the severity of the thermal treatment
DOE

N81-23315# Institute of Gas Technology, Chicago, Ill
COAL GASIFICATION PILOT PLANT SUPPORT STUDIES Quarterly Report, 1 Oct - 31 Dec 1979

Oct 1980 134 p

(Contract DE-AC21-78ET-11330)

(FE-2806-7) Avail NTIS HC A07/MF A01

Coal gasification research programs support gasification pilot plant operations but are not limited to them As a result programs were developed to also study chemical reactions in gasification fluidized bed reactors processing product and waste gases and improved methods of coal feed preparation The objectives and technical progress in these areas and, in some cases subdivisions of them are presented
DOE

N81-23316# Exxon Research and Engineering Co., Linden, NJ
FUNDAMENTAL SYNTHETIC FUEL STABILITY STUDY Annual Report, 1 May 1979 - 30 Apr 1981

J W Frankenfeld Feb 1981 96 p refs

(Contract DE-AC19-79BC-10045)

(DOE/BC-10045/12 AR-1) Avail NTIS HC A05/MF A01

A variety of organic nitrogen compounds were evaluated for their tendencies to promote sediment in hydrocarbon fuels under accelerated storage conditions Three diluents were employed pure n-decane petroleum derived JP-8 and No 2 diesel fuel The fuels and fuel mixtures were stored at 1100 F and 1500 F in the dark The most deleterious species to fuel stability were found to be alkylated heterocyclic nitrogen compounds The most reactive compounds were those with two or more alkyl groups at least one of which was situated on a carbon adjacent to the nitrogen A highly deleterious compound is 2,5 dimethyl-pyrrole

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(DMP) Other nitrogen compounds such as amines amides and nonalkylated heterocycles were found to interact with deleterious nitrogen compounds to promote sediment formation. With the exception of sulfonic acids, none of the sulfur or oxygen compounds studied produced sediment when tested by themselves. DOE

N81-23317# Massachusetts Inst of Tech, Cambridge Dept of Chemical Engineering
CROSSED REACTION NETWORKS IN THE CATALYTIC HYDRODENITROGENATION OF SYNTHETIC LIQUID FUELS Quarterly Report, 1 Nov 1980 - 30 Jan 1981
Charles N Satterfield and Shan Hsi 1981 17 p
(Contract DE-AC22-80PC-30075)
(DOE/PC-30075/4) Avail NTIS HC A02/MF A01

The trickle bed reactor system was brought into operation and sample analysis by gas chromatography was refined. Whether or not unsuspected homogeneous reactions may contribute significantly to the reaction network of quinoline under typical HDN conditions was explored. Details are presented on the following: the automatic shut down system, application of a capillary column in the gas chromatographic analysis, absolute response factors obtained for various compounds in gas chromatographic analysis, thermocracking of liquid carrier under HDN conditions, possibility of 1,2,3,4 tetrahydroquinoline or 5,6,7,8 tetrahydroquinoline acting as a homogeneous hydrogen donor or hydrogen acceptor in the quinoline reaction network, and homogeneous reaction of quinoline under HDN conditions. DOE

N81-23318# West Virginia Univ Morgantown Dept of Geology and Geography
ANALYSIS OF THE STRUCTURAL PARAMETERS THAT INFLUENCE GAS PRODUCTION FROM THE DEVONIAN SHALE, VOLUME 1 Annual Progress Report, 1979 - 1980
J Negus-DeWys, Jeanette M Dixon, Mark A Evans, Kevin D Lee, James Ruotsala, Thomas H Wilson, and Richard T Williams
Oct 1980 35 p refs
(Contracts DE-AC21-76ET-12138 DE-AC21-76MC-05194)
(DOE/ET-12138/T1-Vol-1) Avail NTIS HC A03/MF A01

The results and progress of efforts toward understanding shale gas production from the Devonian shale in Appalachia are presented. A correlation was found between the geochemical parameters of the shale in eastern Kentucky and shale gas production there. Tasks on resource inventory, tasks and shale characterization include regional structure studies, production studies, geophysical studies, structure studies, fracture density and orientation, and fracture studies. DOE

N81-23319# Department of Energy, Washington, D C Assistant Secretary for Fossil Energy
ANALYSIS OF THE MARKET AND PRODUCT COSTS FOR COAL-DERIVED HIGH BTU GAS STAFF WORKING PAPER
Dec 1980 54 p
(DOE/FE-0011) Avail NTIS HC A04/MF A01

This analysis is based upon supply and demand projections that reflect the effects of natural gas deregulation, recent large oil price increases, and new or pending legislation designed to reduce oil imports. Product economics are based upon estimates developed by the staff of the Office of Plans and Technology Assessment using internal DOE studies and published data. While these data are believed to be representative of the costs to produce high Btu gas from coal using advanced gasification technology that is ready for technical demonstration at commercially relevant scales, they are not based upon detailed design studies. The analysis indicates that an increasingly large market for supplemental gas is expected to open up by 1990 and that high Btu gas from advanced technology is likely to be economically superior to gas imports over a wide range of alternative assumptions. DOE

N81-23321# West Virginia Univ, Morgantown
COAL GASIFICATION AVAILABILITY ANALYSIS Annual Report, Aug 1979 - Sep 1980
C Y Wen Sep 1980 59 p refs Sponsored by Gas Research Inst
(PB81-153272, GRI-79/0075) Avail NTIS HC A04/MF A01 CSCL 10A

An availability analysis technique was applied to coal

gasification in order to develop an easy method for determining the practical thermodynamic efficiencies of coal gasification processes and the unit operations involved in these processes. Availability analyses based on both the first and second laws of thermodynamics were made on the Lurgi, Texaco, and Exxon gasification processes. These analyses are based on three known sets of thermodynamic reference states and are being compared to a suggested new set of reference states. A computer code for evaluating thermophysical properties of gas mixtures and liquid mixtures is being compiled and further tested. GRA

N81-23322# Cornell Univ Ithaca N Y Dept of Agricultural Economics
ETHANOL PRODUCTION IN NORTHERN NEW YORK: TECHNICAL AND ECONOMIC FEASIBILITY Final Report, Apr - Sep 1980
Robert J Kalter, Richard N Boisvert, Eric C Gabler, Larry P Walker, Roger A Pellerin, Andy M Rao, and Yong D Hang
Sep 1980 336 p refs
(PB81-144438, NYSEDA-80-22) Avail NTIS HC A15/MF A01 CSCL 05C

The technical and economic viability of converting cheese whey to ethanol is examined at a variety of scales and with two alternative technologies. In addition, the use of corn as a supplementary feedstock to extend economies of scale is investigated. For the scales of operation and potential locations studied (New York State's North Country Counties Lewis, Jefferson, St Lawrence, and Franklin), whey conversion was found to be feasible and profitable, using presently available equipment and techniques. In the North Country alone, more than one billion pounds of cheese whey is left over from the manufacture of cheese annually. The whey is a costly disposal problem for manufacturers. It is estimated that waste could be turned into 2.5 million gallons of ethanol. Ethanol, when blended with unleaded gasoline in a 9:1 ratio, produces gasohol, an octane booster and a gasoline extender. GRA

N81-23323# Bureau of Mines, Avondale Md Avondale Research Center
DEVELOPMENT OF ANALYTICAL REFERENCE MATERIALS FOR REFUSE-DERIVED FUELS
Stephen L Law, Benjamin W Haynes, and William J Campbell
1980 17 p refs
(PB81-135030, BM-RI-8426) Avail NTIS HC A02/MF A01 CSCL 21D

Municipal solid waste (MSW) represents a significant source of metals and glass together with a combustible fraction that could be used to supplement coal and oil and in generating heat and electricity. Because of increasing interest in this fuel supplement, a refuse-derived fuel material was prepared as a proposed reference material for use by other laboratories to evaluate their analytical procedures. This material was prepared by combining MSW light combustibles from three cities, then shredding, milling, and blending the composite material. Homogeneity of the refuse-derived fuel reference material appears to be acceptable based on analytical values for replicate analyses. Concentration data for major, minor, and trace elements together with proximate analyses are provided. GRA

N81-23324# Midwest Research Inst, Kansas City Mo
PROCESSING EQUIPMENT FOR RESOURCE RECOVERY SYSTEMS VOLUME 2: MAGNETIC SEPARATORS, AIR CLASSIFIER AND AMBIENT AIR EMISSIONS TESTS Final Report
B W Simister and David Bendersky Jul 1980 172 p
(Contract EPA-68-03-2387)
(PB81-141590, EPA-600/2-80-007B-Vol-2) Avail NTIS HC A08/MF A01 CSCL 21D

The results of a study of equipment and systems for processing municipal solid wastes into energy related products are presented. The study was divided into three phases. The first phase was devoted to a study of the state of the art and formulation of the research needs. The second phase was devoted to field tests of magnetic separators, air classifier, and air emissions. The third phase is involved with field tests of shredders. GRA

N81-23334# Arkansas Univ Fayetteville Dept of Civil Engineering
CONSTRUCTION PROCEDURES USING SELF HARDENING FLY ASH Final Report
Sam I Thornton and David G Parker Jul 1980 95 p refs

(PB81-153884 FHWA/AR-80/004) Avail NTIS
HC A05/MF A01 CSCL 13B

Fly ash produced in Arkansas from burning Wyoming low sulfur coal is self-hardening and can be effective as a soil stabilizing agent for clays and sands. The strength of soil-self hardening fly ash develops rapidly when compacted immediately after mixing. Seven day unconfined compressive strengths up to 1800 psi were obtained from 20% fly ash and 80% sand mixtures. A time delay between mixing the fly ash with the soil and compaction of the mixture reduced the strength. With two hours delay over a third of the strength was lost and with four hours delay, the loss was over half. Gypsum and some commercial concrete retarders were effective in reducing the detrimental effect of delayed compaction. Adequate mixing of the soil and fly ash and rapid compaction of the mixtures were found to be important parameters in field construction of stabilized bases. GRA

**N81-23370# Ruhrkohle A.G., Essen (West Germany)
FLAMEPROOF TELEVISION CAMERA SET FOR THE
OBSERVATION OF COAL SEAMS AND ROCK STRATA AS
WELL AS OF TECTONIC SURFACES IN UNDERGROUND
BOREHOLES Final Report**

Wolfgang Brenken and Bruno Wegener Bonn Bundesministerium fuer Forschung und Technologie Dec 1980 100 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-80-149 RAG-163) Avail NTIS (US Sales Only) HC A05/MF A01 DOE Depository Libraries

A TV camera set comprising smaller structural elements was designed and subjected both to comprehensive tests as well as to practical trials for identification of any weak points. All the components of the TV camera set including the small cable hoist fit in one transport case which minimizes the risk of damages during transport. Since the dimensions of the casings were reduced they can be rapidly placed at the borehole mouth. The cable hoist allows a constant speed of introduction/withdrawal. Ease of evaluation was provided for by inserting a data line in the image and by storing the borehole image on video tape. A compressed air-operated cable hoist as well as 66 bar test pressure on the probe sleeves allow an observation of boreholes as deep as 600 m. Borehole television is a simple and economic means of exploration ahead of coal faces in order to safely complete information on deposits. The observation of boreholes of more than 600 m depth requires different technologies. DOE

**N81-23393# Midwest Research Inst Golden Colo Solar
Energy Research Inst**

**ELECTRIC UTILITY VALUE DETERMINATION FOR WIND
ENERGY VOLUME 1 A METHODOLOGY**

C David Percival and James R Harper Feb 1981 89 p refs (Contract EG-77-C-01-4042)

(SERI/TR-732-604-Vol-1) Avail NTIS HC A05/MF A01

A method electric utilities can use to determine the value of wind energy systems is described. It is performed by a package of computer models that can be used with most utility planning models. The final output of these models gives a financial value (\$/kW) of the wind energy system under consideration in the specific utility system. This report the first of two volumes describes the value determination method and gives detailed discussion on each computer program available. DOE

**N81-23394# Midwest Research Inst Golden Colo Utility
Applications and Policy Branch**

**ELECTRIC UTILITY VALUE DETERMINATION FOR WIND
ENERGY VOLUME 2 A USER'S GUIDE**

C David Percival and James R Harper Feb 1981 115 p (Contract EG-77-C-01-4042)

(SERI/TR-732-604-Vol-2) Avail NTIS HC A05/MF A01

A method for determining the value of wind energy systems to electric utilities is described. It is performed by a package of computer models available from SERI that can be used with most utility planning models. The final output of these models gives a financial value (\$/kW) of the wind energy system under consideration in the specific utility system. This is a user's guide for the computer programs available from SERI. DOE

N81-23429# Brown Univ Providence R I Div of Engineering

NEXT STEPS IN TWO-PHASE FLOW EXECUTIVE SUMMARY

Ronald DiPippo Sep 1980 59 p Presented at the Symp on the Next Steps in Two-Phase Flow Providence 21 Jul 1980 (Contract DE-AC02-79ET-27225)

(DOE/ET-27225/12 CONF-800786 GEOFLO/8) Avail NTIS HC A04/MF A01

The following topics are discussed: the state of affairs; the fundamental governing equations; the one dimensional mixture model; the drift flux model; the Denver Research Institute two-phase geothermal flow program; two-phase flow pattern transition criteria; a two-fluid model under development; the mixture model as applied to geothermal well flow; DRI downwell instrumentation and two-phase flow instrumentation; Information on the Sperry Research Corporation downhole pump and gravity-head heat exchanger systems and the Brown University two-phase flow experimental program are also presented. DOE

**N81-23460# Energy and Minerals Research Co Exton Pa
EFFICIENT ULTRASONIC GRINDING A NEW TECHNOLOGY FOR MICRON-SIZED COAL Quarterly Technical
Progress Report, 16 Mar - 15 Jun 1980**

W B Tarpley Jr P L Howard, and G R Moulder 1 Jul 1980 18 p

(Contract DE-AC02-79ER-10466)

(DOE/ER-10466/T2 QTPR-3) Avail NTIS HC A02/MF A01

Design and development of the dual roller comminution apparatus based on operation and evaluation of the cylinder segment test apparatus was explored. Determinations of the degree of preferential liberation of pyrite and ash inclusions were conducted and the ultrasonic effect was demonstrated. In preliminary tests 67% of the pyrite and at least 21% of the ash inclusions were liberated and were amenable to settling collection in the -10 micron size range. Larger scale testing is conducted to expand the data base and better quantify the degree of preferential liberation. DOE

**N81-23468# Energy and Minerals Research Co Exton Pa
EFFICIENT ULTRASONIC GRINDING A NEW TECHNOLOGY FOR MICRON-SIZED COAL Quarterly Technical
Progress Report, 16 Dec 1979 - 15 Mar 1980**

W B Tarpley, Jr P L Howard and G R Moulder 3 Apr 1980 22 p

(Contract DE-AC02-79ER-10466)

(DOE/ER-10466/T3 QTPR-2) Avail NTIS HC A02/MF A01

Varying the mechanical gain of the ultrasonic comminution apparatus increased the strain amplitude of the system and enhanced fines production. These features used with an ultrasonic cylinder segment apparatus resulted in 276% increase in the production of -10 micron fines over that generated by passing coal through a non-activated control. The Phase I apparatus offers the flexibility of operating with either traveling or standing ultrasonic waves. Varying the physical configuration (dual-roller or roller plate) and the mode of ultrasonic activation (traveling or standing wave) allows for cost effective testing of four different techniques. Additionally, operating frequency was reduced to 15 kHz to permit use of off-the-shelf hardware in apparatus assembly and thus expedite testing. Selection of four representative, well-characterized coals was completed. DOE

**N81-23473# General Electric Co., Schenectady, N Y Gas
Turbine Div**

**HIGH-TEMPERATURE TURBINE TECHNOLOGY PROGRAM
TURBINE SIMULATOR TESTS WITH COAL-DERIVED
LOW-Btu GAS FUEL**

M W Horner Nov 1980 155 p refs

(Contract DE-AC01-76ET-10340)

(FE-1806-92) Avail NTIS HC A08/MF A01

The component design and technology testing of a large water cooled composite turbine nozzle and a low-Btu gas fuel combustor for an integrated gasification combined cycle power plant are discussed. DOE

**N81-23550*# National Aeronautics and Space Administration
Earth Resources Labs Bay St Louis, Miss
WESTERN ENERGY RELATED OVERHEAD MONITORING**

04 FUELS AND OTHER SOURCES OF ENERGY

PROJECT PHASE 2 SUMMARY Progress Report, 1 Jan 1977 - 30 Jun 1978

James E Anderson Principal Investigator Jan 1979 113 p refs Original contains color imagery Original photography may be purchased from the EROS Data Center, Sioux Falls SD 57198 ERTS

(E81-10141 NASA-TM-82328 Rept-176) Avail NTIS HC A06/MF A01 CSCL 08F

Assistance by NASA to EPA in the establishment and maintenance of a fully operational energy-related monitoring system included (1) regional analysis applications based on LANDSAT and auxiliary data (2) development of techniques for using aircraft MSS data to rapidly monitor site specific surface coal mine activities and (3) registration of aircraft MSS data to a map base The coal strip mines used in the site specific task were in Campbell County Wyoming, Big Horn County Montana and the Navajo mine in San Juan County New Mexico The procedures and software used to accomplish these tasks are described A R H

N81-23552# Comptroller General of the United States, Washington, D C

OIL AND NATURAL GAS FROM ALASKA, CANADA, AND MEXICO- ONLY LIMITED HELP FOR US Report to the Congress

11 Sep 1980 93 p refs

(EMD-80-72) Avail NTIS HC A05/MF A01

The potential effect of Alaskan, Canadian, and Mexican oil and gas development on the U S domestic energy situation and energy policies is assessed Particular emphasis is given to factors affecting the willingness and ability of Canada and Mexico to provide increased quantities of these resources to the United States and to factors delaying further oil and gas exploration and development in Alaska A R H

N81-23568# North Dakota Univ, Grand Forks Engineering Experiment Station

EVALUATION OF HYDROTHERMAL RESOURCES OF NORTH DAKOTA, PHASE 1 Final Technical Report

Kenneth L Harris Laramie M Winczewski, Howard R Umphrey and Sidney B Anderson 1 Apr 1980 181 p refs

(Contract DE-FC07-79D-012030)

(DOE/ID-12030/12) Avail NTIS HC A09/MF A01

An analysis of existing data on file with the North Dakota Geological Survey (NDGS) and other state and federal agencies is made The principle source of data used was the oil and gas well files maintained by the NDGS A computer library was created containing all the necessary oil and gas well data in the North Dakota Geological Survey oil and gas well files, Stratigraphic data bottomhole temperature data and chemical data are presented to map form to show the geothermal gradient, temperature and depth of potential hydrothermal aquifers and the chemical characteristics of potential hydrothermal aquifers

DOE

N81-23569# Virginia Polytechnic Inst and State Univ Blacksburg Dept of Mining and Minerals Engineering

DESIGN OPTIMIZATION IN UNDERGROUND COAL SYSTEMS VOLUME 6. LHDSIM A LOAD-HAUL-DUMP SIMULATOR FOR ROOM-AND-PILLAR MINING SYSTEMS Final Report

Feb 1981 270 p refs

(Contracts DE-AC01-76ET-10722 EX-76-C-01-1231)

(FE-1231-24-Vol-6) Avail NTIS HC A04/MF A01

The simulator is a combination deterministic and stochastic model and test runs insure its operational capability The potential application is primarily for equipment selection and evaluation in a load-haul-dump underground mining system with either conventional or continuous mining equipment The computer program provides an excellent method of evaluating the use of load-haul-dump systems of varying capacity and may be used to compare the productive potential of this method, with conventional loading/hauling devices and systems DOE

N81-23570# Eaton Industries of Houston, Inc Tex

TESTING GEOPRESSURED GEOTHERMAL RESERVOIRS IN EXISTING WELLS Annual Report

1980 75 p

(Contract DE-AC08-80ET-27081)

(DOE/ET-27081/2) Avail NTIS HC A04/MF A01

Wells of Opportunity are located by screening published

information on oil industry activity and through personal contacts with oil operators This process resulted in recommendation of 21 candidate wells to the DOE for the WOO program Of the 21 wells recommended 7 were accepted Six of these 7 were acquired for testing Three wells were tested, and preliminary test results are briefly described and are shown in a table The actual testing schedule and the originally proposed matched very closely Cumulative costs through November 1980 were approximately \$65 million and compare to an estimate of \$85 million for the same period A graphical comparison of actual versus estimated costs is given DOE

N81-23571# ICF, Inc, Washington D C

COAL RESOURCE INFORMATION VOLUME 1 COAL RESOURCE INFORMATION REQUIREMENTS Final Report

J M Eyster, D E Klein and D R Walton Dec 1980 99 p refs

(EPRI Proj 868-1)

(EPRI-EA-673-Vol-1) Avail NTIS HC A05/MF A01

Coal resource information is defined as data on in situ coal resources (e.g. seam thickness, hydrologic data and depth of overburden) and the physical and chemical properties of coal (e.g. proximate analysis sulfur composition and grindability) which affect its mineability or usability All data necessary for each of seven categories of production and use are included extraction, beneficiation transporting loading and storage carbonization combustion, gasification, and liquefaction The findings are the outcome of a 1977 survey of experts in all areas of coal production and use DOE

N81-23572# ICF, Inc Washington D C

COAL RESOURCE INFORMATION, VOLUME 2 PART 1 REVIEW OF MAJOR RESOURCE STUDIES AND ONGOING RESEARCH Final Report

J M Eyster, D E Klein and D R Walton Dec 1980 145 p refs

(EPRI Proj 868-1)

(EPRI-EA-673-Vol-2-Pt-1) Avail NTIS HC A07/MF A01

Selected major research studies of U S coal resources are reviewed Published and ongoing research reports are divided into general national, regional, and coal quality categories Information statement of the intended purpose(s), and judgement as to how well that purpose was executed is summarized Tables, maps, and other illustrations are provided Listings of ongoing research projects are organized by state headings with the additional heading of United States for studies whose geographic scope is larger than a single state Each entry provides bibliographical information as to author sponsoring organization title, and approximate dates of the project A brief paragraph description of the substance of the project is presented DOE

N81-23573# Argonne National Lab III Energy and Environmental Systems Div

ILLINOIS BIOMASS RESOURCES ANNUAL CROPS AND RESIDUES, CANNING AND FOOD-PROCESSING WASTES, PRELIMINARY ASSESSMENT

Antonios A Antonopoulos Jun 1980 118 p refs

(Contract W-31-109-eng-38)

(ANL/EMR-6) Avail NTIS HC A06/MF A01

Crops, crop residues and food-processing wastes in Illinois were studied as energy sources The effects of their use on both agriculture and industry were appraised biomass energy conversion systems were analyzed and products that could be generated from biomass were environmentally and economically evaluated Of the 39 x 10⁶ tons of residues generated in 1978 in Illinois from seven main crops, about 85% is collectible The thermal energy equivalent of this material is 658 x 10⁶ Btu or 0.66 quad And by fermenting 10% of the corn grain some 323 million gallons of ethanol could have been produced in 1978 Another 3 million gallons of ethanol could have been produced in the same year from wastes generated by the state's food-processing establishments DOE

N81-23574# Virginia Polytechnic Inst and State Univ Blacksburg Dept of Mining and Minerals Engineering

DESIGN OPTIMIZATION IN UNDERGROUND COAL SYSTEMS VOLUME 9 MODIFIED FACESIM AND COST-SCHED PROGRAMS Final Technical Report

28 Feb 1981 198 p

(Contracts DE-AC01-76ET 10722 EX-76-C-01-1231)

E(49-18)-1231)

(FE-1231-27-Vol-9) Avail NTIS HC A09/MF A01

The modified FACESIM and COST-SCHED computer programs include the following options (1) a routine which simplifies the input data cards required by the original FACESIM program (2) provisions to plot graphically the output of FACESIM program (3) an integrated computer program which includes the original and two later versions as options of the FACESIM suite of programs the Two Roofbolters and the Battery Haulage versions and (4) an expansion of the COST-SCHED program to compute ash BTU sulfur and reject values as the coal is mined The modified programs may be used in a variety of applications including evaluation of mining conditions and methods designing section layouts, evaluating and designing new equipment justifying capital expenditures developing and maintaining production schedules and quality control standards DOE

N81-23575# Virginia Polytechnic Inst and State Univ, Blacksburg Dept of Mining and Minerals Engineering
DESIGN OPTIMIZATION IN UNDERGROUND COAL SYSTEMS VOLUME 3 STRUCTURAL CHARACTERIZATION OF COAL Final Technical Report

Feb 1981 272 p refs

(Contracts DE-AC01-76ET-10722 EX-76-C-01-1231,

E(49-18)-1231)

(FE-1231-21-Vol-3) Avail NTIS HC A12/MF A01

An extensive number of specimens, representing 14 major coal seams in the nation were tested and the following results were obtained coal strength is dependent upon the loading rate recommended range 50 to 150 psi/sec, results indicated a random distribution of uniaxial compressive strength regarding the moisture content the elastic modulus appeared to be independent of the specimen size given equivalent areas and W/H ratios a difference existed between the strengths of cubical and cylindrical specimens and when applied to the Holland-Gaddy pillar design equations this strength difference can substantially alter pillar sizes and hence the extraction ratio A procedure was developed for modifying the traditional pillar-design equation so that it may be used in conjunction with drill-core strength data An example is presented to illustrate the application of this approach Such a procedure may prove invaluable when developing new mining properties for which cubical coal samples are not available DOE

N81-23576# Virginia Polytechnic Inst and State Univ, Blacksburg Dept of Mining and Minerals Engineering
DESIGN OPTIMIZATION IN UNDERGROUND COAL SYSTEMS VOLUME 7 PREDICTION OF MINING SUBSIDENCE AND RELATED PARAMETERS OVER LONGWALL MINING OPERATIONS Final Technical Report

28 Feb 1981 118 p refs

(Contracts DE-AC01-76ET-10722 EX-76-C-01-1231)

(FE-1231-25) Avail NTIS HC A06/MF A01

A computerized method for the prediction of mining subsidence is developed The mechanics of mining subsidence are reviewed The prediction of subsidence by mathematical methods based on the theories of elasticity, viscoelasticity, viscoplasticity, and the use of influence functions is described Subsidence prediction by the zone-area method and by the graphical method is described The components of mining damage with particular emphasis on structural damage to structures are analyzed A subsidence simulation program is presented J D H

N81-23582# Bureau of Mines Amarillo Tex Helium Field Operations

HELIUM RESOURCES OF THE UNITED STATES, 1979

B J Moore 1980 33 p refs

(PB81-150146 BM-IC-8831) Avail NTIS HC A03/MF A01 CSDL 08E

The helium resources are reported in four categories (1) helium in measured natural gas reserves and in storage (2) helium in indicated natural resources (3) helium in hypothetical natural gas resources and (4) helium in speculative natural gas resources GRA

N81-23587# Bureau of Mines Amarillo Tex Helium Operations

HELIUM ITS RELATIONSHIP TO GEOLOGIC SYSTEMS AND ITS OCCURRENCE WITH THE NATURAL GASES, NITROGEN, CARBON DIOXIDE AND ARGON

Claude A Tongish 1980 185 p refs

(PB81-151995 BM-RI-8444) Avail NTIS HC A09/MF A01 CSDL 08G

Information on the accumulation and distribution of helium in U.S. natural gas reservoirs is presented The investigation concerns the relationship or association of helium with geographic location geologic age reservoir depth nitrogen carbon dioxide and argon The report is based on gas analysis information collected by the Bureau from 1917 to 1974 from 10 086 gas samples representing 6 455 reservoirs in 35 states Results of the various correlations are presented in tables and charts Relationships have also been determined quantitatively by measures of correlation These data can be used with other information for predicting the future helium resources of the United States GRA

N81-23593# Bureau of Mines Twin Cities, Minn Twin Cities Research Center

STRUCTURE RESPONSE AND DAMAGE PRODUCED BY AIRBLAST FROM SURFACE MINING

David E Siskind Virgil J Stachura Mark S Staggs and John W Kopp 1980 121 p refs

(PB91-148918 BM-RI-8485) Avail NTIS HC A06/MF A01 CSDL 08I

Airblast from surface mining was studied to assess its damage and annoyance potential and to determine safe levels and appropriate measurement techniques Research results obtained from direct measurements of airblast produced structure responses damage and analysis of instrument characteristics are combined with studies of sonic booms and human responses to transient overpressures Of four methods, only the 0.1 Hz high-pass linear method accuracy measures the total airblast energy present Where a single airblast measuring system must be used, the 2 Hz linear peak response is the best overall compromise The human response and annoyance problem from airblast is caused primarily by secondary noises Although these will not entirely be precluded by the recommended levels they are low enough to preclude damage to residential structures and any possible human injury over the long term GRA

N81-23596# Dartmouth Coll Hanover NH School of Engineering

ADVANCED SYSTEM DEMONSTRATION FOR UTILIZATION OF BIOMASS AS AN ENERGY SOURCE, EXECUTIVE SUMMARY

Marion McCollom ed, Thomas Adler Karen Altman, Mollie Beatie Lauren Brown, Jane Difley William T Glidden, Jr Andrew Heller Elizabeth Hicks Susan Knight et al Sep 1980 49 p Prepared for Rust Engineering Co 8 Vol

(DOE/ET-20055/T3-Exec-Summ RP-291) Avail NTIS HC A03/MF A01

Impacts on the natural and human environment expected to result from the construction operation, and fueling of proposed wood-fuel power plants in Maine are summarized The environmental impacts of alternative supplementary fuels are discussed DOE

N81-23631# Sterling Hobe Corp Washington, D C
MARKET STUDY FOR DIRECT UTILIZATION OF GEOTHERMAL RESOURCES BY SELECTED SECTORS OF ECONOMY

Aug 1980 225 p

(Contract DE-AC01-80RA-50108)

(DOE/RA-50108/T1) Avail NTIS HC A10/MF A01

A comprehensive analysis is presented of industrial markets potential for direct use of geothermal energy by a total of six industry sectors food and kindred products, tobacco manufactures textile mill products lumber and wood products (except furniture), chemicals and allied products and leather and leather products Location determinants and potential for direct use of geothermal resources are presented The data was gathered through interviews with 30 senior executives in the six sectors of economy selected for study Probable locations of plants in geothermal resource areas and recommendations for geothermal resource marketing are presented DOE

N81-23634# Global Weather Consultants, Inc., San Jose, Calif
WIND ENERGY RESOURCE ATLAS VOLUME 9 THE SOUTHWEST REGION

R L Simon, G T Norman D L Elliott W R Barchet, and R

04 FUELS AND OTHER SOURCES OF ENERGY

L George Nov 1980 128 p refs Prepared for Battelle Pacific Northwest Labs
(Contract DE-AC06-76RL-01830)
(PNL-3195WERA-9-Vol-9) Avail NTIS HC A07/MF A01

This atlas is composed of introductory and background information a regional summary of the wind resource, and assessments of the wind resource in Nevada and California. Background on how the wind resource is assessed and on how the results of the assessment should be interpreted is presented. A description of the wind resource on a regional scale is then given. The results of the wind energy assessments for each state are assembled into an overview and summary of the various features of the regional wind energy resource. An introduction and outline to the descriptions of the wind resource given for each state are given. DOE

N81-23636# Energetics Corp, Richardson Tex
DIRECT APPLICATION OF GEOTHERMAL ENERGY AT THE L'EGGS PRODUCT PLANT, LAS CRUSES, NEW MEXICO
Final Report

Gary N Bond, John H Boucher, Warren T Eriksen Steven L Hudson and Bryan D Kaiser Feb 1981 136 p refs
(Contract DE-AC07-79ID-12047)
(DOE/ID-12047/3) Avail NTIS HC A07/MF A01

Five separate sites were evaluated initially as to geothermal potential and technical feasibility. Preliminary analysis revealed that three sites were considered normal, but that two sites (about three miles from the L'eggs Plant) had very high shallow subsurface temperature gradients. An initial engineering analysis showed that to meet the Leggs plant temperature and energy requirements a geothermal fluid temperature of about 250 F and 200 gpm flow rate would be necessary. A brief economic comparison indicated that the L'eggs plant site and a geothermal site approximately four miles from the plant did merit further investigation. DOE

N81-23664# Wheelabrator Cleanfuel Corp Washington D C
ADVANCED SYSTEMS DEMONSTRATION FOR UTILIZATION OF BIOMASS AS AN ENERGY SOURCE VOLUME 2 TECHNICAL SPECIFICATIONS

Oct 1980 600 p Revised 8 Vol
(Contracts DE-AC06-77ET-20055 EG-77-R-06-1036)
(DOE/ET-20055/T2-Vol-2) Avail NTIS HC A25/MF A01

Specifications relating to materials and construction of a biomass cogeneration facility in Maine are presented. DOE

N81-23667# Wheelabrator Cleanfuel Corp Washington, D C
ADVANCED SYSTEM DEMONSTRATION FOR UTILIZATION OF BIOMASS AS AN ENERGY SOURCE VOLUME 4 DESIGN DRAWINGS

Oct 1980 671 p Revised 8 Vol
(Contracts DE-AC06-77ET-20055 EG-77-R-06-1036)
(DOE/ET-20055/T2-Vol-4) Avail NTIS HC A99/MF A01

Design drawings for a biomass cogeneration plant are presented which show a considerable degree of detail, but which are not to be considered released for construction. DOE

N81-23679# Wood Energy Inst Camden, Maine
ADVANCED SYSTEM DEMONSTRATION FOR UTILIZATION OF BIOMASS AS AN ENERGY SOURCE

Oct 1980 215 p refs Revised
(Contract EG-77-R-06-1036)
(DOE/ET-20055/T5) Avail NTIS HC A10/MF A01

Efforts of a 20 month study to explore the technical and economic feasibility of fuelwood utilization to operate a 50 megawatt energy conversion facility are described. The availability of biomass as a fuel source, the methods of harvesting and collecting the fuelstock, the costs of providing adequate fuel to the plant, and other requirements for fueling the proposed conversion facility are investigated. DOE

N81-23690# Midwest Research Inst Golden Colo
BIOMASS ENERGY SYSTEMS INFORMATION USER STUDY

W W Belew B L Wood T L Marle and C L Reinhardt Feb 1981 277 p
(Contracts DE-AC02-77CH-00178 EG-77-C-01-4042)

(SERI/TR-751-748) Avail NTIS HC A13/MF A01

A series of telephone interviews with groups of users of information on biomass energy systems are described. These results, part of a larger study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. Results from 13 biomass groups of respondents are analyzed in this report. Federally Funded Researchers (2 groups), Nonfederally Funded Researchers (2 groups), Representatives of Manufacturers (2 groups), Representatives of State Forestry Offices, Private Foresters, Forest Products Engineers, Educators, Cooperative Extension Service County Agents, and System Managers. DOE

N81-23699# Argonne National Lab, Ill Energy and Environment Systems Div

DISTRICT HEATING FROM ELECTRIC-GENERATING PLANTS AND MUNICIPAL INCINERATORS LOCAL PLANNERS ASSESSMENT GUIDE

W Pferdehirt and N Kron Jr Nov 1980 117 p refs
(Contract W-31-109-eng-38)
(ANL/CNSV-12) Avail NTIS HC A06/MF A01

The preliminary evaluation of the feasibility of district heating using heat recovered from electric generating plants and municipal incinerators is outlined. System feasibility is indicated by (1) the existence of an adequate supply of nearby waste heat, (2) the presence of a sufficiently dense and large thermal load and (3) a favorable cost comparison with conventional heating methods. DOE

N81-23701# Los Alamos Scientific Lab N Mex
REVIEW OF THE GEOTHERMAL RESERVOIR WELL STIMULATION PROGRAM

Donald A Campbell (Republic Geothermal, Inc), Robert J Hanold A Richard Sinclair (Naurer Engineering, Inc) and Otto J Vetter (Vetter Research) 1981 20 p Presented at the Intern Geothermal Drilling and Completions Technol Conf Albuquerque, N Mex 21 Jan 1981

(Contract W-7405-eng-36)
(LA-UR-81-26, CONF-810105-3) Avail NTIS HC A02/MF A01

The overall program and the four experimental fracture stimulation treatments completed to date are described. Two stimulation experiments were performed at the Raft River, Idaho, Known Geothermal Resource Area (KGRA) in late 1979. This is a naturally fractured hard rock reservoir with a relatively low geothermal resource temperature (300 F). A conventional planar hydraulic fracture job was performed in Well RRGP-5 and a Kiel dendritic (or reverse flow) technique was utilized in Well RRGP-4. In mid-1980, two stimulation experiments were performed at the East Mesa, California KGRA. The stimulation of Well 58-30 provided the first geothermal well fracturing experience in a moderate temperature (350 F) reservoir with matrix type rock properties. The two treatments consisted of a conventional hydraulic fracture of a deep, low permeability zone and a minifrac Kiel treatment of a shallow, high permeability zone in the same well. DOE

N81-23716# Kentucky Univ, Lexington Dept of Chemical Engineering

HOT-GAS DESULFURIZATION 1. USE OF GASIFIER ASH IN A FIXED-BED PROCESS Final Report

J Thomas Schrodt 1 Apr 1980 262 p
(Contracts DE-AS05-76ET-10463, E(40-1)-5076, EY-76-S-05-5076)

(DOE/ET-10463/T1-Vol-1) Avail NTIS HC A12/MF A01

A method for removing gaseous sulfur compounds from coal derived fuel gases through their reaction with the iron in gasifier coal ash was thoroughly researched and the results applied for design of a commercial scale, fixed bed desulfurization process. Ashes with 5-23 weight percent iron oxide were used in small reactors to sorb hydrogen sulfide from synthesized low Btu fuel gas. Carbonyl sulfide and carbon disulfide are also removed indirectly after hydrogenation to hydrogen sulfide. A mixture of sulfur dioxide and sulfur is recovered during regeneration of spent ashes. DOE

N81-23756# Sandia Labs Albuquerque N Mex
LONG-TERM MEASUREMENTS OF GROUND MOTIONS OFFSHORE

Eric W. Reese and David E. Ryerson 1981 4 p refs Presented at the Intern Conf on Recent Advan in Geotech Earthquake and Soil Dyn., St. Louis, 26 Apr 1981 (Contract DE-AC04-76DP-00789) (SAND-80-2718C, CONF-810412-1) Avail NTIS HC A02/MF A01

Long-term measurements of earthquake ground motions offshore show that offshore ground motions may in certain cases be substantially different from empirically predicted ground motions based on onshore data. In particular, the attenuation effects of soft and/or gassy soils, the wedging of offshore deposits as a function of direction to and distance from the source, and sharp velocity depth profiles, are shown to be possible factors contributing to such differences. The offshore ground motions are only 13 to 23 percent of those which would be calculated using empirical predictions based on onshore data. Measurements are needed to evaluate the earthquake hazards of offshore energy developments and to provide firm data on the design parameters required for the harvesting of offshore energy resources. DOE

N81-23977# Edgerton Germeshausen and Grier, Inc. Idaho Falls, Idaho

PROPANE CONVERSION IN THE VEHICLE FLEET AT THE IDAHO NATIONAL ENGINEERING LABORATORY

John Crone Dec 1980 10 p (Contract DE-AC07-76ID-01570) (EGG-TRANS-5291) Avail NTIS HC A02/MF A01

One hundred fifty seven pickups, 9 three ton trucks, and 3 jeeps were converted from gasoline to propane. The conversion to propane reduced use of gasoline during the FY 1980 transition period by 111,000 gal, and lowered the fuel cost by \$63,000, based on cost of gasohol (which otherwise replaced gasoline). Total gasoline savings for this year (which include the propane conversion, the switch to gasohol and a mileage reduction of 8%) is estimated at 196,000 gal of gasoline, or 32 percent less than FY 1979 consumption. The rate of fuel cost savings indicate that the payback of the conversion cost for all 170 vehicles (\$165,896) will be made in approximately 2 to 5 years. DOE

N81-24210# California Univ Berkeley Lawrence Berkeley Lab Materials and Molecular Research Div

CHEMISTRY AND MORPHOLOGY OF COAL LIQUEFACTION

Annual Report, 1 Oct 1979 - 30 Sep 1980

H. Heinemann Sep 1980 36 p refs

(Contract W-7405-eng-48)

(LBL-12308) Avail NTIS HC A03/MF A01

Experimental results are reported in the areas of hydrogen transfer mechanisms and catalysis and organo-metallic chemistry. A few of the significant results in these and other areas are the evidence for catalysis in hydrogen transfer from tetralin, a novel and possibly very important new synthesis of alkyl aromatics from benzene, carbon monoxide, and hydrogen; the study of coals in the transmission electron microscope identifying coal macerals, minerals and metals and leading to the possibility of observing location of and catalytic influences on pyrolysis and hydrogenation at elevated temperatures; the finding that scales formed on deactivated cobalt-molybdena-alumina-hydrogenation catalysts contain not only metals from the liquid feedstocks but also molybdenum sulfide which must derive from migration from the catalyst interior to and beyond the surface. Insights gained in mechanisms of pyrolysis, hydrogenation, hydrogen transfer, and indirect liquefaction of coal promise to lead to improving technology by defining problem areas and showing routes to by-pass problems. DOE

N81-24220# Bureau of Mines, Pittsburgh Pa
SPONTANEOUS COMBUSTION SUSCEPTIBILITY OF U.S. COALS Report of Investigations, 1980

J. M. Kuchta, V. R. Rowe and D. S. Burgess 1980 44 p refs

(PB81-150039 BM-R1-8474) Avail NTIS HC A03/MF A01 CSCI 081

The chemical and thermal criteria used for predicting the spontaneous combustion hazard are briefly reviewed and data are presented to characterize the gas desorptions and self heating tendencies of 29 U.S. coals. Closed vessel desorption experiments showed that CO, CO₂ and CH₄ are the main gases evolved and that the CO/CO₂ index and O₂ absorption rate increase with decreasing rank and increasing oxygen content of

the coal. The effects of temperature, moisture and other variables are discussed together with the application of the data to the complex conditions encountered in a mining environment. An important finding is that the presence of CO alone in a mine is not necessarily an indication of a self-heating reaction of the coal. GRA

N81-24283*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

EFFECT OF HYDROPROCESSING SEVERITY ON CHARACTERISTICS OF JET FUEL FROM OSCO 2 AND PARAH0 DISTILLATES

George M. Prok, Francisco J. Flores, and Gary T. Seng Jun 1981 20 p refs

(NASA-TP-1768 E-617) Avail NTIS HC A02/MF A01 CSCI 21D

Jet A boiling range fuels and broad-property research fuels were produced by hydroprocessing shale oil distillates, and their properties were measured to characterize the fuels. The distillates were the fraction of whole shale oil boiling below 343 C from TOSCO 2 and Paraho syncrudes. The TOSCO 2 was hydroprocessed at medium severity, and the Paraho was hydroprocessed at high medium and low severities. Fuels meeting Jet A requirements except for the freezing point were produced from the medium severity TOSCO 2 and the high severity Paraho. Target properties of a broad property research fuel were met by the medium severity TOSCO 2 and the high severity Paraho except for the freezing point and a high hydrogen content. Medium and low severity Paraho jet fuels did not meet thermal stability and freezing point requirements. E D K

N81-24284# Virginia Polytechnic Inst and State Univ Blacksburg

THE 1H AND 13C FOURIER TRANSFORM NMR CHARACTERIZATION OF JET FUELS DERIVED FROM ALTERNATE ENERGY SOURCES Six Month Progress Report, Apr - Sep 1980

H. C. Dorn 1980 41 p refs

(AD-A098305) Avail NTIS HC A03/MF A01 CSCI 20/4

This report discusses LC-superscript 1H NMR studies from semi-preparative to analytical column size in order to establish ultimate chromatographic resolution conditions. It explores quantitative approaches for LC-superscript 1H NMR including a dual effluent stream to allow introduction of a quantitative reference before the superscript 1H NMR detector. It explores quantitative and ultimate sensitivity limits for the present superscript 1H NMR LC detector including optimization of superscript 1H NMR insert for LC-superscript 1H NMR. The report provides LC-superscript 1H NMR data profiles for 10 synthetic mixtures and corresponding analytical data (e.g. total %H, %H, aromatic, %H aliphatic, %n-alkanes and branched alkanes, % alkyl aromatics and substituted naphthalenes). LC-superscript 1H NMR data profiles for 30 middle distillate fuels and corresponding analytical data is provided. This report provides static superscript 1H NMR and superscript 13C NMR quantitative data for 45 middle distillate fuels. At least six of these samples will be diesel fuel marine. It also provides static superscript 1H NMR and superscript 13C NMR quantitative data for 20 synthetic mixtures of hydrocarbons. GRA

N81-24286# Colorado School of Mines Golden Research Inst

PARAMETERS AFFECTING THE CHARACTERISTICS OF OIL SHALE-DERIVED FUELS

Mar 1981 148 p refs

(Contract DAAK70-80-C-0174)

(AD-A098242) Avail NTIS HC A07/MF A01 CSCI 20/4

Under the terms of the Defense Production Act, it is expected that as the U.S. oil shale industry develops, the Armed Forces of the United States will be the recipients of significant quantities of fuel products derived from shale oil. Lead responsibility for the preparation of fuel specifications for DF-1, DF-2, and DFA fuels has been charged to the U.S. Army, and in order to prepare realistic specifications for these fuels, the Army must be fully aware of all the parameters that will ultimately affect the characteristics of these fuels. The objective of this research program was to collect, review, and evaluate all pertinent information dealing with the parameters that affect the properties of shale-derived fuels. To varying degrees, the critical parameters were found to be the source of the oil shale, method of

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retorting, retorting conditions, method and degree of upgrading, and refining techniques employed. With all other factors being equal, each of the above parameters will have an effect on the fuel properties, however, the flexibility inherent in the refining step permits all but the most major variations in shale oil properties to be compensated for in this operation. This report describes all of the parameters that are likely to affect the characteristics of shale-derived fuels, with emphasis on the most significant parameters: retorting and refining. **GRA**

N81-24287# Rockwell International Corp., Canoga Park, Calif
Energy Systems Group

MOLTEN SALT COAL GASIFICATION PROCESS DEVELOPMENT UNIT, PHASE 1. VOLUME 2: COMMERCIAL PLANT STUDY Final Report

May 1980 105 p

(Contract DE-AC03-77ET-10296)

(DOE/ET-10296/66-Vol-2) Avail NTIS HC A06/MF A01

The conceptual design of a grass roots, 500 MW, combined cycle power generating station is presented in which the coal feed is converted to low Btu gas fuel for gas turbines by the molten salt coal gasification process. Based on process flowsheets and major component design parameters, capital and operating cost estimates were prepared. The plant consumes 4600 tons per day of Illinois No. 6 coal and produces 85,500 MM Btu/day of low Btu fuel gas, 98.4% of which is fed to the gas turbines. The gas turbines are designed for 2000 F inlet temperature and are based on United Technology V84-3 machine. The derived economics show that the 500-MW plant can generate electricity at an average selling price of 27.9 mills/kw hr. The calculated overall thermal efficiency is 38.1 (without sulfur credit) at a plant heat rate of 8,958 Btu/Kw hr. The total plant investment is estimated at 318 million dollars while the total capital requirement is estimated at 397 million dollars (all costs based on first quarter 1980 dollars). **ED K**

N81-24288# Stone and Webster Engineering Corp., N Y
NORTHEAST COAL UTILIZATION PROGRAM, PHASE 2 Final Report

Jan 1981 175 p refs

(EPRI Proj 1078)

(EPRI-AP-1671) Avail NTIS HC A08/MF A01

Coal liquefaction by hydrogenation processes is the focus of studies related to technology and economics to commercial project development, and to plant siting. Achievement of significant coal liquefaction capacity in place is recognized to be hindered by technical risk and lack of economic incentive as the nation adjusts to the use of heavy, high sulfur crude oils. Against this background, the concept is developed of a convertible plant capable of functioning in both coal liquefaction and in heavy oil upgrading. Construction of a single train coal liquefaction facility based on purchasing hydrogen and other services from an adjacent oil refinery is considered as a method of introducing first generation coal liquefaction plants at minimum risk. Coal liquefaction in which distillable, low sulfur liquid products are made appears to be the most economical approach. **DOE**

N81-24293# Pittsburg Univ., Pa. Dept. of Chemistry
STUDY OF PRECOMBUSTION METHODS OF CHEMICAL COAL CLEANING Final Report

Kenneth D. Jordan 1980 38 p refs

(Contract DE-AO22-79PC-20083)

(DOE/PC-20083/T1) Avail NTIS HC A03/MF A01

Sixteen of the major processes for chemical coal cleaning were considered. Particular emphasis was placed on the capabilities of each of the processes for the removal of the various types of sulfur commonly found in coal. In many cases information concerning the diffusivity of the reagents and the reactivity of the various organic sulfur functional groups in the coal matrix (before and after treatment) is scarce or lacking. Since the organic sulfur functional groups are tied to the coal and, hence, are relatively immobile, one cannot, in general, fill this void by simple extrapolating from the results obtained using single model compounds which may have very different reactions. The situation is further complicated by the lack of data on the sulfur distribution in a coal before and after treatment in a given process. Usually analysis is conducted only for total sulfur and total organic sulfur. **DOE**

N81-24294# Iowa State Univ. of Science and Technology,

Ames Dept. of Chemical Engineering

PHYSICAL AND CHEMICAL COAL CLEANING

T. D. Wheelock and R. Markuszewski 1980 52 p refs. Presented at the Conf. on the Chem. and Phys. of Coal Util., Morgantown, W. Va., 2-4 Jun 1980.

(Contract W-7405-eng-82)

(IS-M-287 CONF-8006116-2) Avail NTIS HC A04/MF A01

Coal is cleaned industrially by freeing the occluded mineral impurities and physically separating the coal and refuse particles on the basis of differences in density, settling characteristics or surface properties. While physical methods are very effective and low in cost when applied to the separation of coarse particles, they are much less effective when applied to the separation of fine particles. Also they cannot be used to remove impurities which are bound chemically to the coal. Most of the chemical cleaning methods under development are designed primarily to remove sulfur from coal but several methods also remove various trace elements and ash-forming minerals. Generally these methods remove most of the sulfur associated with inorganic minerals but only a few of the methods seem to remove organically bound sulfur. A number of the methods employ oxidizing agents such as air, oxygen, chlorine, nitrogen dioxide, or a ferric salt to oxidize the sulfur compounds to soluble sulfate which are then extracted with water. **DOE**

N81-24295# Los Alamos Scientific Lab., N. Mex.

METHANE HYDRATE GAS PRODUCTION BY THERMAL STIMULATION

Patrick L. McGuire 1981 22 p refs. Presented at the 4th Canadian Permafrost Conf., Calgary, Alberta, 2-6 Mar 1981.

(Contract W-7405-eng-36)

(LA-UR-81-645, CONF-810317-1)

Avail NTIS

HC A03/MF A01

Two models were developed to bracket the expected gas production from a methane hydrate reservoir. The frontal sweep model represents the upper bound on the gas production and the fracture flow model represents the lower bound. Parametric studies were made to determine the importance of a number of variables, including porosity, bed thickness, injection temperature, and fracture length. These studies indicate that the hydrate-filled porosity should be at least 15%; reservoir thickness should be about 25 ft or more, and well spacing should be fairly large (maybe 40 acres/well) if possible. Injection temperatures should be probably be between 150 and 250 F to achieve an acceptable balance between high heat losses and unrealistically high injection rates. Numerous important questions about hydrate gas production remain unanswered. **DOE**

N81-24297# Imhausen-Chemie G.m.b.H., Lahr (West Germany)

OPTIMIZING THE COMBINATION FISCHER-TROPSCH SYNTHESIS AND GASIFICATION WITH COAL HYDROGENATION FOR THE PRODUCTION OF MOTOR FUELS Final Report

Karl-Heinz Imhausen, Norbert Heger, Karl-Heinz Eisenlohr, Friedrich Schnur, Franz Straetz, Artur Vinke, Hans Gaensslen, Hans Teggers, Uwe Lenz, Dieter Kirchof et al. Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 52 p refs. In GERMAN, ENGLISH summary. Sponsored by Ministerium fuer Forschung und Technologie. Prepared in cooperation with Lurgi Kohle und Mineraloeltechnik G.m.b.H., Frankfurt; Rheinische Braunkohlenwerke AG, Cologne; Ruhrchemie AG, Oberhausen, West Germany; Ruhrkohle AG, Essen; Salzgitter Industriebau G.m.b.H., West Germany; Uhde G.m.b.H., Dortmund, West Germany.

(BMFT-FB-T-80-048 ISSN-0340-7608)

Avail NTIS

HC A04/MF A01

As part of a follow-on feasibility study of the conversion of coal into liquid motor fuels, the optimum design of a processing plant was considered. The plant capacity is set at 3 million tons of fuel and liquid gas per year, while brown coal or stone coal are to be used as raw materials. Product output should break down to 45% gasification fuel, 45% diesel oil and 10% liquid gas. Different solutions for both brown coal and stone coal which meet these specifications are identified; however, their economic feasibility depends on developing markets for gas byproducts in order to reduce production costs.

Author (ESA)

N81-24452# Combustion Electromagnetics Inc., Lexington, Mass.

EFFECTS OF MICROWAVES ON THE PERFORMANCE OF INTERNAL-COMBUSTION ENGINES Final Technical Report, 30 Sep 1979 - 31 Jan 1981

Michael A V Ward 31 Jan 1981 73 p refs

(Contract DE-AC04-78ET-13116)

(DOE/ET-13116/T13) Avail NTIS HC A04/MF A01

The interaction of microwaves with the flame in a combustion bomb and an appropriately designed single-cylinder test engine is studied. High power microwave energy is applied to the bomb and test engine in order to stimulate the combustion processes. Work was performed on the microwave properties of conventional and modified engine combustion chambers by means of an engine simulator. Work on plasma jet ignition (as one ignition source for the microwave work) was continued. Information is presented on the microwave coupling system, high power microwave testing on a combustion bomb, and the fabrication of facilities for testing a single-cylinder test engine. The combined plasma jet/microwave system is used to advantage to burn very lean mixtures and increase their flame speed. DOE

N81-24455# Energy and Minerals Research Co. Exton, Pa. **EFFICIENT ULTRASONIC GRINDING. A NEW TECHNOLOGY FOR MICRON-SIZED COAL** Final Report, 15 Sep 1979 - 14 Dec. 1980

W B Tarpley, Jr., P L Howard, and G R Moulder Jan 1981 40 p refs

(Contract DE-AC02-79ER-10499)

(DOE/ER-10466/1) Avail NTIS HC A03/MF A01

To burn coal most efficiently and cleanly, much smaller particle sizes are needed than can now be ground economically. This project was performed to demonstrate the technical feasibility of using ultrasonics to enhance grinding below the standard plant grind of 75 microns, and the extrapolate from this laboratory work the ultrasonic energy requirements for production use. Successively improved laboratory arrays demonstrated a repeatable production of particulates from 200 micron coal to the desired size ranges (approximately 35% below 7 microns, 95% below 44 microns) with selective liberation of ash and pyrite inclusions to facilitate removal with equipment translatable to production use and the possibility of only 37 kwh/ton energy input requirement. DOE

N81-24506*# Jet Propulsion Lab. California Inst of Tech. Pasadena

A MOVING BASELINE FOR EVALUATION OF ADVANCED COAL EXTRACTION SYSTEMS

Charles R Bickerton and M Dean Westerfield 15 Apr 1981 180 p refs. Sponsored by NASA and DOE

(NASA-CR-164363 JPL-Pub-81-31 DOE/ET-12548/5) Avail NTIS HC A09/MF A01 CSCL 081

Results from the initial effort to establish baseline economic performance comparators for a program whose intent is to define, develop, and demonstrate advanced systems suitable for coal resource extraction beyond the year 2000 are reported. Systems used were selected from contemporary coal mining technology and from conservation conjectures of year 2000 technology. The analysis was also based on a seam thickness of 6 ft. Therefore, the results are specific to the study systems and the selected seam extended to other seam thicknesses. JMS

N81-24507# Department of Energy. Washington D C. Energy Information Administration

US CRUDE OIL AND NATURAL GAS RESERVES, 1978 Annual Report

Sep 1980 73 p refs

(DOE/EIA-0216/78) Avail NTIS HC A04/MF A01

Analysis of data filed by operators of domestic oil and gas wells on Form EIA-23, Annual Survey of Domestic Oil and Gas Reserves, indicates that as of December 31, 1978, the United States proved reserves of crude oil were 31,355 million barrels, excluding lease condensate and other natural gas liquids. Proved reserves of dry natural gas were 208,033 billion cubic feet, exclusive of gas contained in underground storage. These proved reserves estimates are associated with sampling errors of less than 0.8 percent at a 95 percent confidence level. Overall survey response rate was 98 percent. Comparison of 1978 annual production estimates from this survey with production data tabulated earlier by the EIA from state sources indicates no significant undercoverage of the Form EIA-23 survey frame. DOE

N81-24508# Colorado School of Mines. Golden. Dept of Chemical and Petroleum Refining Engineering

ROLE OF SPENT SHALE IN OIL SHALE PROCESSING AND THE MANAGEMENT OF ENVIRONMENTAL RESIDUES

Final Technical Report, Jan 1979 - May 1980

Anthony L Hines 15 Aug 1980 154 p refs

(Contract DE-AC20-79LC-10020)

(DOE/ETC-10020/1) Avail NTIS HC A08/MF A01

The adsorption of hydrogen sulfide on retorted oil shale was studied at 10, 25, and 60 C using a packed bed method. Equilibrium isotherms were calculated from the adsorption data and were modeled by the Langmuir, Freundlich, and Polanyi equations. The isosteric heat of adsorption was calculated at three adsorbent loadings and was found to increase with increased loading. A calculated heat of adsorption less than the heat of condensation indicated that the adsorption was primarily due to Van der Waals' forces. Adsorption capacities were also found as a function of oil shale retorting temperature with the maximum uptake occurring on shale that was retorted at 750 C. DOE

N81-24509# New Mexico Inst of Mining and Technology, Socorro. Petroleum Recovery Research Center

DEVELOPMENT OF MOBILITY CONTROL METHODS TO IMPROVE OIL RECOVERY BY CO2 Annual Report, 1 Oct 1979 - 30 Sep. 1980

John P Heller and Joseph J Taber Mar 1981 33 p refs

(Contract DE-AC21-79MC-10689)

(DOE/MC-10689/5 AR-1) Avail NTIS HC A03/MF A01

Topics include the fundamental mechanisms of displacement and displacement instability in porous media, field tests and laboratory experiments on CO2 flooding, and the methods which were proposed to alleviate the low sweep efficiency caused by unfavorable mobility ratio. These suggested methods were grouped into three categories of mobility control procedures. They all involve the reduction of the displacing fluid mobility. The first of the three methods is called Water Alternated with Gas or WAG for short. A second method which was proposed for mobility control is the use of foam - a dispersion of gas or solvent in water. Several early studies demonstrated the marked increase in flow resistance when the rock contained such a surfactant-stabilized dispersion. The third proposed mobility control method is the use of thickeners. DOE

N81-24510# National Petroleum Council, Washington D C. **UNCONVENTIONAL GAS SOURCES, EXECUTIVE SUMMARY**

Dec 1980 50 p

(DOE/TIC-11417) Avail NTIS HC A03/MF A01

The long lead time required for conversion from oil or gas to coal and for development of a synthetic fuel industry dictates that oil and gas must continue to supply the United States with the majority of its energy requirements over the near term. In the interim period the nation must seek a resource that can be developed quickly, incrementally, and with as few environmental concerns as possible. One option which could potentially fit these requirements is to explore for, drill, and produce unconventional gas: Devonian Shale gas, coal seam gas, gas dissolved in geopressured brines, and gas from tight reservoirs. The significance of these sources and the economic and technical conditions under which they could be developed are addressed. DOE

N81-24543# Office of Naval Research, London (England)

CLIMATE AND OFFSHORE ENERGY RESOURCES

Paul F Twitchell 30 Dec 1980 11 p. Presented at ONR Conf, London, 21-23 Oct 1980

(AD-A097774, ONRL-C-13-80)

Avail NTIS

HC A02/MF A01 CSCL 04/2

A conference discussed the relationship of climate to the world's offshore energy resources. The conference focused upon such areas as the impact of oil resources upon the economies of developed and developing countries, the importance of providing climatic data in sufficient time to meet users' needs, and the hazards and financial burdens associated with the development of offshore oil reserves. One of the important achievements of the conference was the establishment of better communications between the users of environmental data and those charged with producing predictions. GRA

N81-24558# Northwestern Univ., Evanston Ill. Dept of Civil Engineering

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APPLICATION OF STATISTICAL TECHNIQUES TO WIND CHARACTERISTICS AT POTENTIAL WIND ENERGY-CONVERSION SITES Final Report, 1 Oct 1978 - 30 Sep 1979

Ross B Corotis May 1980 172 p refs

(Contract DE-AS06-76ET-20283)

(DOE/ET-20283/2) Avail NTIS HC A08/MF A01

The distribution for the magnitude of the vector sum of two orthogonal horizontal wind velocity components is often modelled by the Rayleigh which is derived assuming that the components are independent, identically distributed, zero-mean, Gaussian random variables, the probability density function for a more realistic case where the two components are correlated and not equal in variance is derived. It is found that the derived distribution is adequately modelled by the Rayleigh distribution. A 24 hour record of 20 second average wind speed was collected to assess the effect of sampling rate and averaging time on computed wind speed means and variances autocorrelation, and run duration. Definite effects on autocorrelation and run duration due to averaging time and sampling rate respectively are observed. An approximate procedure is developed to simulate the time sequence of wind speed at a single site the procedure uses a Weibull distribution with conditional parameters updated each hour as a function of the previously simulated value and the autocorrelation. DOE

N81-24575# Los Alamos Scientific Lab N Mex

HEAT PIPES FOR INDUSTRIAL WASTE HEAT RECOVERY

M A Merrigan 1981 12 p refs Presented at the 8th Energy Technol Conf, Washington, D C 10 Mar 1981

(Contract W-7405-eng-36)

(LA-UR-81-560, CONF-810315-5)

Avail NTIS

HC A02/MF A01

Development work on the high temperature ceramic recuperator at Los Alamos National Laboratory is described and involved material investigations, fabrication methods development compatibility tests heat pipe operation, and the modeling of application conditions based on current industrial usage. Solid ceramic heat pipes ceramic coated refractory pipes and high-temperature oxide protected metallic pipes are investigated. Economic studies of the use of heat pipe based recuperators in industrial furnaces are conducted and payback periods determined as a function of material fabrication, and installation cost. DOE

N81-24578# Combustion Engineering, Inc Windsor, Conn C-E Power Systems Dept

EVALUATION AND DEMONSTRATION OF METHODS FOR IMPROVED FUEL UTILIZATION Semiannual Progress Report, Sep 1979 - Mar. 1980

U Decher 25 Jun 1980 44 p refs Prepared in cooperation with Omaha Public Power District Nebr

(Contract DE-AC02-79ET-34010)

(COO-34010-1, CEND-382, SAPR-1)

Avail NTIS

HC A03/MF A01

Two techniques for improving fuel utilization in current Pressurized Water Reactors are demonstrated more efficient fuel management and high burnup. More efficient fuel management will be achieved through the implementations of a low leakage concept called SAVFUEL (Shimmed and Very Flexible Uranium Element Loading), which is expected to reduce uranium requirements by 2 to 4%. The burnup will be increased sufficiently to reduce uranium requirements by 5 to 15%. DOE

N81-24579# Radian Corp, Austin Tex

GEOTHERMAL ANALYTICAL REPORT

1980 9 p

(Contract DE-AC02-79ET-27026)

(DOE/ET-27026/T6, DCN-80-212-003-X)

Avail NTIS

HC A02/MF A01

Two samples were precracked by fatigue and exposed to separated geothermal brines in a closed autoclave. Final load and crack length were measured and a fractographic examination performed on compact double cantilever beam samples. The fractographs are shown. DOE

N81-24583# Battelle Pacific Northwest Labs, Richland, Wash INVESTIGATIONS ON CATALYZED STEAM GASIFICATION OF BIOMASS

L K Mudge, S L Weber, D H Mitchell, L J Sealock Jr and R J Robertus Jan 1981 162 p refs

(Contract DE-AC06-76RL-01830)

(PNL-3695) Avail NTIS HC A08/MF A01

The technical and economic feasibility of producing specific gas products via the catalytic gasification of biomass are evaluated. Results of research conducted from December 1977 to October 1980 are presented. Laboratory studies were conducted to develop operating conditions and catalyst systems for generating methane-rich gas, synthesis gases hydrogen, and carbon monoxide, these studies also developed techniques for catalyst recovery, regeneration and recycling. A process development unit was designed and constructed to evaluate laboratory systems at conditions approximating commercial operations. The economic analyses evaluated the feasibility of adapting the wood-to-methane and wood-to-methanol processes to full-scale commercial operations. Plants were designed in the economic analyses to produce fuel-grade methanol from wood and substitute natural gas from wood via catalytic gasification with steam. DOE

N81-24584# Northwestern Univ Evanston, Ill Dept of Civil Engineering

HANDBOOK FOR THE APPLICATION OF STATISTICAL TECHNIQUES TO WIND CHARACTERISTICS AT POTENTIAL WIND-ENERGY-CONVERSION SITES Final Report, 1 Oct 1978 - 30 Sep 1979

Ross B Corotis May 1980 29 p refs

(Contract DE-AS06-76ET-20283)

(DOE/ET-20283/3) Avail NTIS HC A03/MF A01

Effective utilization of data in determining the wind regime is important in gaining the most reliable information necessary to assess turbine performance and generated power in a relatively short period of on-site collection. This handbook specifically discusses adjustment procedures and reliability measures for the mean wind speed at a site selection of a probability distribution for the hourly wind speed and calibration from observed data employment of a probability model for wind speed persistence, speed at a site and array power from a region. A brief discussion of the limitations implicit in National Weather Service data is also included. DOE

N81-24588# Cube Ingenieurunion G m b H Worms (West Germany)

DEVELOPMENT OF AN OPTIMIZING METHOD FOR THE DESIGN OF A BURIED PIPELINE SYSTEM TO BE USED AS A HEAT SOURCE FOR HEAT PUMPS Final Report

Hans Ludwig vonCube, Edgar Ludwig, Johann Sattlegger (Ingenieurbuero Sattlegger), and Juergen Rohde (Ingenieurbuero Sattlegger) Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 317 p refs In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie Original contains color illustrations

(BMFT-FB-T-80-121, ISSN-0340-7608)

Avail NTIS

HC A14/MF A01

A calculation method suitable for EDP calculation with difference steps for space and time, which allows the representation of isothermic lines and the calculation of heat flow to and from the ground as well as freezing processes by the solution of a two dimensional linear operator (Crank-Nicolson method), was developed. The physical characteristics of the ground were assessed, including heat transmission into the air and to deeper surface layers. Theoretical and mathematical methods of calculating ground temperature fields were then reviewed. Design criteria are determined, concerning the pipe laying method, the dimensioning of the pipe, and the predicted density of heat flow. Author (ESA)

N81-24591# Ruhrkohle A G, Essen (West Germany)

COAL PROCESSING PLANTS Final Report

Walter Bitterlich, Thomas Bohn, H-Guenter Eickhoff, Horst Geldmacher, Wolfgang Mengis, Hassan Oomatia, and K-Guenter Stoppel Bonn Bundesministerium fuer Forschung und Technologie Aug 1980 149 p refs In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie Prepared in cooperation with Essen Univ, West Germany and Kernforschungsanlage Juelich GmbH, West Germany Original contains color illustrations

(BMFT-FB-T-80-097, ISSN-0340-7608)

Avail NTIS

HC A07/MF A01

The efficient design of processing plants which combine various coal based technologies in order to maximize the effectiveness of coal utilization is considered. The technical,

economical and ecological virtues which compound plants for coal conversion offer are assayed. Twenty-two typical processes of coal conversion and product refinement are selected and described by a standardized method of characterization. An analysis of product market and a qualitative assessment of plant design support six different compound plant propositions. The incorporation of such coal conversion schemes into future energy supply systems was simulated by model calculations. The analysis shows that byproducts and nonconverted materials from individual processes can be processed in a compound plant in a profitable manner. This leads to an improvement in efficiencies. The product spectrum can be adapted to a certain degree to demand variations. Furthermore, the integration of fluidized bed combustion can provide an efficient method of desulfurization. Compound plants are expected to become economic in the 1990's. A necessary condition to compound technologies is high reliability in the functioning of all individual processes. Author (ESA)

N81-24683*# Jet Propulsion Lab, California Inst of Tech, Pasadena

WIND SPEED STATISTICS FOR GOLDSTONE, CALIFORNIA, ANEMOMETER SITES

M Berg, R Levy, H McGinness, and D Strain. 15 Apr 1981. 73 p. ref. Sponsored by NASA. (NASA-CR-164364, JPL-Pub-81-17) Avail NTIS HC A05/MF A01 CSCL 04B

An exploratory wind survey at an antenna complex was summarized statistically for application to future windmill designs. Data were collected at six locations from a total of 10 anemometers. Statistics include means, standard deviations, cubes, pattern factors, correlation coefficients and exponents for power law profile of wind speed. Curves presented include: mean monthly wind speeds, moving averages, and diurnal variation patterns. It is concluded that three of the locations have sufficiently strong winds to justify consideration for windmill sites. EAK

N81-24692# Alaska Univ., Anchorage Arctic Information and Data Center

WIND ENERGY RESOURCE ATLAS VOLUME 10 ALASKA REGION

J L Wise, T Wentink, Jr, R Becker, Jr, A L Comiskey, D L Elliott (Pacific Northwest Lab), W R Barchet (Pacific Northwest Lab), and R L George (Pacific Northwest Lab). Dec 1980. 181 p. refs.

(Contract DE-AC06-76RL-01830) (PNL-3195-WERA-10) Avail NTIS HC A09/MF A01

Background is presented on how the wind resource is assessed and on how the results of the assessment should be interpreted. A description of the wind resource on a state scale is given. The results of the wind energy assessments for each subregion are assembled into an overview and summary of the various features of the Alaska wind energy resource. An outline to the descriptions of the wind resource given for each subregion is included. The subregion wind energy resources are described in greater detail than is the Alaska wind energy resource, and features of selected stations are discussed. DOE

N81-24695# Environmental Research and Technology Inc., Concord, Mass

WIND ENERGY RESOURCE ATLAS VOLUME 3 GREAT LAKES REGION

D L Paton, A Bass, D G Smith, D L Elliott (Battelle Pacific Northwest Lab, Richland, Wash), W R Barchet (Battelle Pacific Northwest Lab, Richland, Wash), and R L George (Battelle Pacific Northwest Lab, Richland, Wash). Feb 1981. 187 p. refs. Prepared for Battelle Pacific Northwest Lab.

(Contract DE-AC06-76RL-01830) (PNL-3195-WERA-3-Vol-3) Avail NTIS HC A09/MF A01

The Great Lakes Region atlas assimilates six collections of wind resources data: one for the region and one for each of the five states that compose the Great Lakes region: Illinois, Indiana, Michigan, Ohio, Wisconsin. At the state level, features of the climate, topography, and wind resource are discussed in greater detail than in the regional discussion and the data locations on which the assessment is based are mapped. Variations over several time scales in the wind resource at selected stations in each state are shown on graphs of monthly average and interannual wind speed and power, and of hourly average wind speed for

each season. Other graphs present speed, direction, and duration frequencies of the wind at these locations. DOE

N81-24686# Battelle Pacific Northwest Labs, Richland, Wash WIND RESOURCE ASSESSMENT IN THE NORTHWEST UNITED STATES

W R Barchet. Aug 1980. 3 p. refs. Presented at the Natl Conf on Renewable Energy Technol, Honolulu, Hawaii, 7 Dec 1980.

(Contract DE-AC05-76RL-01830) (PNL-SA-8875, CONF-801203-6) Avail NTIS HC A02/MF A01

The northwest United States includes three of the wind resource assessment regions delineated by the Pacific Northwest Laboratory (PNL): the Northwest region (Idaho, Montana, Oregon, Washington, and Wyoming), the Alaska region, and the Hawaii region (Hawaii and the Trust Territories of the Pacific). Detailed wind energy resource assessment atlases were prepared for each of these regions; the highlights are presented. DOE

N81-25180# Kentucky Univ, Lexington Dept of Chemical Engineering

HOT-GAS DESULFURIZATION VOLUME 2 USE OF GASIFIER ASH IN A FLUIDIZED-BED PROCESS Final Report

J Thomas Schrodt. 1 Feb 1981. 329 p. refs.

(Contract DE-AS05-76ET-10463) (DOE/ET-10463/T1-Vol-2) Avail NTIS HC A15/MF A01

Three gasifier coal ashes were used as reactant/sorbents in batch fluidized beds to remove hydrogen sulfide from hot, made-up fuel gases. It is predominantly the iron oxide in the ash that reacts with and removes the hydrogen sulfide; the sulfur reappears in ferrous sulfide. Sulfidized ashes were regenerated by hot, fluidizing streams of oxygen in air; the sulfur is recovered as sulfur dioxide, exclusively. Ash sorption efficiency and sulfur capacity increase and stabilize after several cycles of use. These two parameters vary directly with the iron oxide content of the ash and process temperature, but are independent of particle size in the range 0.01 - 0.02 cm. A western Kentucky No. 9 ash containing 22 weight percent iron as iron oxide sorbed 4.3 weight percent sulfur at 1200 F with an ash sorption efficiency of 0.93 at ten percent breakthrough. A global, fluidized bed, reaction rate model was fitted to the data and it was concluded that chemical kinetics is the controlling mechanism with a predicted activation energy of 19,600 Btu/lb mol. Iron oxide reduction and the water gas shift reaction were two side reactions that occurred during desulfurization. The regeneration reaction occurred very rapidly in the fluid bed regime and it is suspected that mass transfer is the controlling phenomenon. DOE

N81-25230*# Spectra Research Systems Inc., Huntsville, Ala ADVANCED TECHNOLOGY APPLICATIONS FOR SECOND AND THIRD GENERAL COAL GASIFICATION SYSTEMS Final Report

Rodney Bradford, John D Hyde, and C Wendell Mead. 10 Jul 1980. 189 p. refs.

(Contract NAS8-33846) (NASA-CR-181771, SRS/SE-TR80-11) Avail NTIS HC A09/MF A01 CSCL 21D

The historical background of coal conversion is reviewed and the programmatic status (operational, construction, design, proposed) of coal gasification processes is tabulated for both commercial and demonstration projects as well as for large and small pilot plants. Both second and third generation processes typically operate at higher temperatures and pressures than first generation methods. Much of the equipment that has been tested has failed. The most difficult problems are in process control. The mechanics of three-phase flow are not fully understood. Companies participating in coal conversion projects are ordering duplicates of failure-prone units. No real solutions to any of the significant problems in technology development have been developed in recent years. ARH

N81-25231*# Spectra Research Systems Inc., Huntsville, Ala ADVANCED TECHNOLOGY APPLICATIONS FOR SECOND AND THIRD GENERATION COAL GASIFICATION SYSTEMS APPENDIX

Rodney Bradford, John D Hyde, and C Wendell Mead. 10 Jul 1980. 116 p. refs.

(Contract NAS8-33846)

04 FUELS AND OTHER SOURCES OF ENERGY

(NASA-CR-161772 SRS/SE-TR80-11-App) Avail NTIS
HC A06/MF A01 CSCL 21D

Sixteen coal conversion processes are described and their projected goals listed. Tables show the reactants used, products derived, typical operating data, and properties of the feed coal. A history of the development of each process is included along with a drawing of the chemical reactor used. A R H

N81-25233*# Spectra Research Systems Inc. Huntsville, Ala COAL CONVERSION SYSTEMS DESIGN AND PROCESS MODELING VOLUME 1 APPLICATION OF MPPR AND ASPEN COMPUTER MODELS Final Report

1 Jun 1981 200 p refs 2 Vol

(Contract NAS8-34264)

(NASA-CR-161779 SRS/SE-TR81-101-Vol-1) Avail NTIS
HC A09/MF A01 CSCL 21D

The development of a coal gasification system design and mass and energy balance simulation program for the TVA and other similar facilities is described. The materials-process-product model (MPPM) and the advanced system for process engineering (ASPEN) computer program were selected from available steady state and dynamic models. The MPPM was selected to serve as the basis for development of system level design model structure because it provided the capability for process block material and energy balance and high-level systems sizing and costing. The ASPEN simulation serves as the basis for assessing detailed component models for the system design modeling program. The ASPEN components were analyzed to identify particular process blocks and data packages (physical properties) which could be extracted and used in the system design modeling program. While ASPEN physical properties calculation routines are capable of generating physical properties required for process simulation, not all required physical property data are available and must be user-entered. A R H

N81-25234*# Spectra Research Systems Inc., Huntsville Ala COAL CONVERSION SYSTEMS DESIGN AND PROCESS MODELING VOLUME 2: INSTALLATION OF MPPM ON THE SIGNAL 9 COMPUTER Final Report

1 Jun 1981 43 p refs 2 Vol

(Contract NAS8-34264)

(NASA-CR-161780 SRS/SE-TR81-101-Vol-2) Avail NTIS
HC A03/MF A01 CSCL 21D

Relevant differences between the MPPM resident IBM 370 computer and the NASA Sigma 9 computer are described as well as the MPPM system itself and its development. Problems encountered and solutions used to overcome these difficulties during installation of the MPPM system at MSFC are discussed. Remaining work on the installation effort is summarized. The relevant hardware features incorporated in the program are described and their implications on the transportability of the MPPM source code are examined. A R H

N81-25237*# Technology Development Corp., Huntsville Ala COAL CONVERSION PRODUCTS INDUSTRIAL APPLICATIONS Final Report

Dennis Warren and Joseph Dunkin Jul 1980 267 p

(Contract NAS8-33843)

(NASA-CR-161773 TDC-80-019) Avail NTIS
HC A12/MF A01 CSCL 21D

The synfuels economic evaluation model was utilized to analyze cost and product economics of the TVA coal conversion facilities. It is concluded that (1) moderate yearly future escalations (> 6%) in current natural gas prices will result in medium-Btu gas becoming competitive with natural gas at the plant boundary, (2) utilizing DRI price projections, the alternate synfuel products, except for electricity, will be competitive with their counterparts, (3) central site fuel cell generation of electricity, utilizing MBG, is economically less attractive than the other synthetic fuels, given projected price rises in electricity produced by other means, and (4) because of estimated northern Alabama synfuels market demands, existing conventional fuels infrastructure and industrial synfuels retrofit problems, a diversity of transportable synfuels products should be produced by the conversion facility. A R H

N81-25238*# Spectra Research Systems Inc. Huntsville Ala COAL LIQUEFACTION PROCESSES AND DEVELOPMENT REQUIREMENTS ANALYSIS FOR SYNTHETIC FUELS PRODUCTION Final Report

15 Oct 1980 157 p refs

(Contract NAS8-34046)

(NASA-CR-161770, SRS/SE-TR80-12) Avail NTIS
HC A08/MF A01 CSCL 21D

Focus of the study is on (1) developing a technical and programmatic data base on direct and indirect liquefaction processes which have potential for commercialization during the 1980's and beyond and (2) performing analyses to assess technology readiness and development trends, development requirements, commercial plant costs and projected synthetic fuel costs. Numerous data sources and references were used as the basis for the analysis results and information presented. E D K

N81-25243# Exxon Research and Engineering Co. Baytown Tex EXXON CATALYTIC COAL-GASIFICATION PROCESS Quarterly Technical Progress Report, Oct - Dec 1979

Mar 1980 73 p refs

(Contract DE-AC01-78ET-13005)

(DOE/ET-13005/T2) Avail NTIS HC A04/MF A01

Work continued on the catalyst recovery screening studies to evaluate the economic impacts of alternative processing approaches and solid liquid separation current water washing using rotary drum filters for the solid liquid separations. Material and energy balances were completed for an alternative methane recovery process configuration using low pressure stripping which requires 26 percent less horsepower than the Study Design system. A material and energy balance computer model for the CCG reactor system was completed. The new model will provide accurate, consistent and cost efficient material and energy balances for the extensive laboratory guidance and process definition studies planned. DOE

N81-25247# Sandia Labs. Albuquerque N Mex In Situ Technologies Div

APPLICATIONS OF RESERVOIR SIMULATION TO IN SITU COAL GASIFICATION

R E Glass Mar 1981 18 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-2579) Avail NTIS HC A02/MF A01

The results of the Hanna 4B in situ coal gasification test suggest a relationship between the preignition high permeability zones and the subsequent flame front propagation. The problem of the effect of nonuniform permeability on the air flow patterns in a water saturated coal seam is addressed. Specifically, the nonuniformities addressed are those caused by (1) the existence of horizontal high permeability zones in an otherwise homogeneous, isotropic coal, (2) the change in permeability and flow path caused by well completions and location, and (3) the existence of orthotropic permeability. The results indicate that the most favorable condition for reverse combustion linking in underground coal gasification exists when the process wells are aligned with the high permeability direction of an orthotropic coal. The results also demonstrate the importance of proper well completion. DOE

N81-25248# Sandia Labs., Albuquerque, N Mex In Situ Process Div

INSTRUMENTATION AND PROCESS CONTROL DEVELOP- MENT FOR IN SITU COAL GASIFICATION Quarterly Report, Jul - Sep 1980

Stanley E Love, ed Mar 1981 27 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-2878) Avail NTIS HC A03/MF A01

The results of calculations made to determine the influence of various permeability structures on reverse combustion linkage for UCG and the results of heavy oil fireflood mapping by the controlled source audio magnetotelluric (CSAMT) method proposed for UCG process mapping are described. A two phase, two dimensional reservoir model called RESEV was used for the permeability effects work. The results indicate that high permeability horizontal zones, well completion and separation and orthotropic permeability all have significant influence on the success of reverse combustion linkage. Specific conclusions are made which emphasize the need for careful site characterization and for proper well completions. Regarding the second activity, CSAMT-derived resistivity maps provided good descriptions of the progress of the fireflood which is being conducted by BETC near Bartlett, KS. The combustion front apparently did not proceed in a uniform radial manner. DOE

N81-25249# Dynatech R/D Co., Cambridge Mass
LIQUID FUELS PRODUCTION FROM BIOMASS
 P F Levy, J E Sanderson E Ashare D L Wise and M S Molyneux 30 Jun 1980 126 p refs
 (Contract DE-AC02-77ET-20050)
 (DOE/ET-20050/T4) Avail NTIS HC A07/MF A01

The production of liquid hydrocarbon fuels from biomass is discussed. Fermentation processes for the conversion of cellulosic substrates to yield high aliphatic organic acids are addressed along with methods of producing fuels from these acids including pyrolysis and Kolbe electrolysis. In addition the design of a 100 lb/day facility is discussed and the economic factors of the process are analyzed. DOE

N81-25250# Bituminous Coal Research Inc. Monroeville Pa
TEST AND EVALUATE THE TRI-GAS LOW-BTU COAL-GASIFICATION PROCESS Final Report. 21 Oct 1977 - 31 Oct 1980

M G Zabetakis Dec 1980 81 p refs

(Contract DE-AC21-78ET-10254)

(DOE/ET-10254/88) Avail NTIS HC A05/MF A01

The process consists of three fluid bed reactors in series, each having a specific function: stage 1, pretreatment; stage 2, gasification; and stage 3, maximization of carbon utilization. Fifty-nine process and equipment development unit (PEDU) tests were conducted. Both Rosebud and Pittsburgh seam coals were gasified with the PEDU operating in the design mode. Operation with Illinois No. 6 seam coal was also very promising. One of the crucial tasks was to operate the Stage 1 reactor to pretreat and devolatilize caking coals. By adding a small amount of air to the fluidizing gas, the caking properties of the coal can be eliminated. However, it was also desirable to release a high percentage of the volatile matter from the coal in this vessel. In order to accomplish this, the reactor had to be operated above the agglomerating temperature of caking coals. By maintaining a low ratio of fresh to treated coal, this objective was achieved. Both Illinois No. 6 and Pittsburgh seam coals were treated at temperatures of 800 to 900 F without agglomerating in the vessel. DOE

N81-25251# Argonne National Lab III Environmental-Control Technology Program Dept

COAL-OIL-MIXTURE TECHNOLOGY A STATUS REPORT
 J A Lecky Oct 1980 54 p refs

(Contract W-31-109-eng-38)

(ANL/ECT-TM-3) Avail NTIS HC A04/MF A01

The state of the technology in the field of coal-oil-mixture combustion is assessed. Several environmentally acceptable methods are characterized and assessed in terms of performance, costs, applicability, availability, and resource requirements. Consideration is also given to indirect environmental impacts that are either known or foreseeable. RCT

N81-25253# Mitre Corp., McLean, Va
IMPACT OF DEVELOPING TECHNOLOGY ON INDIRECT LIQUEFACTION

David Gray, Milton Lytton, Martin Neuworth and Glen Tomlinson Nov 1980 256 p refs

(Contract EF-77-C-01-2783)

(DOE/ET-10280/T1 MTR-80W326)

Avail NTIS HC A12/MF A01

The status of commercial technology for indirect liquefaction is reviewed. The impact of substituting more advanced gasifiers and synthesis systems is investigated. Slagging BGC/Lurgi, Texaco and Shell-Koppers gasifiers were substituted for the Dry Ash Lurgi units and SASOL SYNTHOL synthesis units were replaced by slurry phase Fischer-Tropsch units. The advanced systems were found to have a highly favorable impact on plant efficiency, product distribution, and gasoline cost. If all the projected technical improvements can be realized for indirect liquefaction, the yields of refined transportation fuels per ton of coal will approach those anticipated for direct liquefaction processes. DOE

N81-25255# Department of Energy, Bartlesville, Okla Energy Technology Center

AVIATION TURBINE FUELS 1980

Ella Mae Shelton Mar 1981 14 p refs

(DOE/BETC/PPS-81/2) Avail NTIS HC A02/MF A01

Properties of some aviation turbine fuels marketed in the United States during 1980 are presented. The samples represented are typical 1980 production and were analyzed in the laboratories of 17 manufacturers of aviation turbine (jet) fuels. The data were submitted for study, calculation, and compilation under a cooperative agreement between the Department of Energy (DOE), Bartlesville Energy Technology Center (BETC), Bartlesville, Oklahoma, and the American Petroleum Institute (API). Results for the properties of 98 samples of aviation turbine fuels are included in the report for military grades JP-4 and JP-5 and commercial type Jet A. DOE

N81-25256# Alternate Energy Associates Inc. Pittsburgh, Pa
SMALL WASTE TO ETHANOL PLANTS, PHASE 1

George F Huff and M Clark Fogle Sep 1980 28 p refs

Sponsored by National Alcohol Fuels Commission

(PB81-160293 NAFC-80-15) Avail NTIS HC A03/MF A01

CSSL 21D

A study is presented of the economics of the conversion of waste cellulose to ethanol through enzyme hydrolysis developed at three production levels: one million five million and ten million gallons per year of motor grade alcohol. The feedstock is the combustible portion of MSW and a nearby waste separation plant is assumed. It is also assumed that the alcohol plant is located inside the fence of an existing operating facility where steam and other utilities and services are available for purchase. No credit is taken for the protein by-product of the fermentation process; it is dried and used as boiler fuel or the parent plant. Study results indicate none of these plants to be competitive without a substantial subsidy. The enzyme technology is too capital intensive to be suitable for small plants. GRA

N81-25271# Cal Recovery Systems Inc., Richmond, Calif
PROCESSING EQUIPMENT FOR RESOURCE RECOVERY SYSTEMS VOLUME 3 FIELD TEST EVALUATION OF SHREDDERS Final Report

George M Savage and Geoffrey R Shifflett Jul 1980 137 p refs 3 Vol

(Contract EPA-68-03-2589 Proj 4426-D)

(PB81-151557 EPA-600/2-80-007C)

Avail NTIS HC A07/MF A01 CSSL 13B

A program to test and evaluate large scale shredders used for the size reduction of solid waste is reported. Tests were conducted on seven horizontal hammermills, one vertical hammermill and one vertical ring shredder at six commercial sites. Both two stage size reduction and single stage size reduction were studied. Analytical relationships among the comminution parameters and the establishment of levels of performance for energy consumption and hammer wear associated with size reduction of solid waste are developed. EAK

N81-25394# Massachusetts Inst of Tech Cambridge School of Chemical Engineering Practice

DEVELOPMENT OF A PACKED-BED LETDOWN VALVE FOR COAL LIQUEFACTION PLANTS

R A Hulseman G H Kemker Jr, and S F Sciamanna Mar 1981 58 p refs

Prepared jointly with ORNL

(ORNL/MIT-321) Avail NTIS HC A04/MF A01

Pressure letdown of coal liquefaction slurry from high pressure (13.9 MPa or 2000 psig) high temperature (730 K) reactor/dissolvers is accomplished using a packed bed. This concept resolves the erosion problem which accompanies the use of conventional valves. Three-phase slurry letdown was simulated using two-phase concurrent upflow, with packed bed pressure drops, to 8.3 MPa (1200 psig). A semiempirical model predicting the pressure gradient for two phase concurrent upflow in a packed bed is presented. Packed bed letdown valve designs which control linear slurry velocity and minimize erosion are presented. Cost analysis indicates carbon steel is an acceptable packing material. DOE

N81-25395# Department of Energy, Morgantown W Va Energy Technology Center

SOLIDS THROTTLING VALVES FOR COAL CONVERSION AND UTILIZATION DEVELOPMENT Final Report

G C Sine Nov 1980 125 p refs

(Contract DE-AC21-79MC-12186)

(DOE/MC-12186/126) Avail NTIS HC A06/MF A01

04 FUELS AND OTHER SOURCES OF ENERGY

A test loop was designed for slurry letdown valves that are compatible with the existing pilot plant and would have a minimum impact on pilot plant operation. The design effort was divided into four task areas: (1) data acquisition and evaluation, (2) conceptual layouts, (3) detailed design drawings and (4) specifications. Design requirements and criteria were developed from the information obtained from interviews with pilot personnel as well as with personnel from supporting agencies. Basic design decisions such as materials of construction, instrumentation, number of test loops, and data acquisition equipment resulted from this effort. Conceptual layouts were prepared using the information obtained from the data acquisition effort and actual field measurements made during visits to the pilot plant. RCT

N81-25475# Główny Inst. Górnictwa, Katowice (Poland) **GEOPHYSICAL METHODS FOR COAL SEAM VARIABILITY DETECTION IN FRONT OF MINING FACE**

Roman Zakolski Jul 1980 29 p refs Sponsored by the Maria Skłodowska-Curie Joint Fund
(DOE/TIC-11444, Rept-1) Avail NTIS HC A03/MF A01

Problems in detecting geologic faults or washouts in coal seams by the use of seismic waves are considered. For transmission, the shot point should not be greater than 500 m from the detection point. A minimum thickness of the seam for transmission is equivalent to the lower limit of thickness for mining. The interpretation of the results is more difficult for thick seams (25 m) and the resolution is lower. The throw of a fault should be equal to the seam thickness or greater; throws of half the thickness can be detected only in favorable conditions and the fault must not be parallel to the propagation. DOE

N81-25476# Alaska Univ., Fairbanks Geophysical Inst **REVIEW OF TECHNOLOGY FOR ARCTIC OFFSHORE OIL AND GAS RECOVERY**

W M Sackinger Aug 1980 105 p refs
(Contract DE-AC01-80ET-14317)
(DOE/ET-14317/T2-Vol-1) Avail NTIS HC A06/MF A01

A five year leasing schedule for the ice-prone waters of the Arctic offshore is presented, which also shows the projected dates of the lease sale for each area. The estimated peak production rates for these areas are given. There is considerable uncertainty for all these production estimates since no exploratory drilling has yet taken place. A flow chart is presented which relates the special Arctic factors such as ice and permafrost, to the normal petroleum production sequence. DOE

N81-25479# Delaware Geological Survey Newark **PRELIMINARY TARGETING OF GEOTHERMAL RE- SOURCES IN DELAWARE** Progress Report, 15 Jul 1979 - 30 May 1980

Kenneth D Woodruff Aug 1980 24 p
(Contract DE-AS02-78ET-28416 ET-78-S-02-4715)
(DOE/ET-28416/2) Avail NTIS HC A02/MF A01

Work completed included additional gravity mapping in southern Delaware, development of a computer program for contouring gravity data, and some preliminary quantitative interpretations of gravity and magnetic data in southern Delaware. No significant changes were made in the original Bouguer gravity map produced during the original contract period as a result of this later mapping. The SYMAP and SCONTOUR computing programs, developed by Harvard Graphics and adapted for the B7700, were used to generate computer drawn Bouguer gravity maps for the study area. Maximum depths calculated for the top of a gravity anomaly in the Bridgeville area ranged from about 2.3 to 2.7 kilometers (7500 to 8000 feet). Depth to magnetic basement in the same general area was calculated to be between about 1.5 and 2.9 kilometers (4920 and 6200 feet). Both gravity and magnetic data agree with trends noted on regional maps and suggest that in selected cases fracture zones beneath the coastal plain might be a possible target for future geothermal exploration. A R H

N81-25488*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio **CONCEPTUAL DESIGN STUDY OF A COAL GASIFICATION COMBINED-CYCLE POWERPLANT FOR INDUSTRIAL COGENERATION**

Harvey S Bloomfield S G Nelson (McKee (Davy) Corp.) H F Straight (McKee (Davy) Corp.) T K Subramaniam (McKee (Davy)

Corp.), and R G Winklepleck (McKee (Davy) Corp.) Mar 1981 49 p
(Contract NAS3-22105-AE)
(NASA-TM-81687 E-723) Avail NTIS HC A03/MF A01 CSCL 10B

A conceptual design study was conducted to assess technical feasibility, environmental characteristics and economics of coal gasification. The feasibility of a coal gasification combined cycle cogeneration powerplant was examined in response to energy needs and to national policy aimed at decreasing dependence on oil and natural gas. The powerplant provides the steam heating and baseload electrical requirements while serving as a prototype for industrial cogeneration and a modular building block for utility applications. The following topics are discussed: (1) screening of candidate gasification sulfur removal and power conversion components, (2) definition of a reference system, (3) quantification of plant emissions and waste streams, (4) estimates of capital and operating costs and (5) a procurement and construction schedule. It is concluded that the proposed powerplant is technically feasible and environmentally superior. E A K

N81-25503*# United Technologies Research Center East Hartford, Conn **AUTOIGNITION CHARACTERISTICS OF NO 2 DIESEL FUEL Final Report**

J A TeVelde and L J Spadaccini Jun 1981 20 p refs
(Contracts NAS3-20066, Contract DE-AI01-77CS-1040)
(NASA-CR-165315 DOE/NASA/0066-2 R81-915281-1)
Avail NTIS HC A02/MF A01 CSCL 21B

Parametric tests to map the ignition delay characteristics were conducted at pressures of 3, 4, and 5 atm inlet air temperatures up to 1150 K and fuel air equivalence ratios ranging from 0.2 to 1.0. Ignition delay times in the range of 6 msec to 60 msec at freestream flow velocities ranging from 10 m/sec to 40 m/sec were obtained. The ignition delay times appeared to correlate with the inverse of pressure and the inverse exponent of temperature. TM

N81-25522# Eaton Industries of Houston, Inc Tex Geopres- sured-Geothermal Program **TESTING GEOPRESSURED GEOTHERMAL RESERVOIRS IN EXISTING WELLS VOLUME 2 WELL TEST DATA**

1981 228 p refs
(Contract DE-AC08-80ET-27081)
(DOE/ET-27081/1-Vol-2) Avail NTIS HC A11/MF A01

Data from the reopening of an abandoned well are presented. The data include reservoir pressure drawdown and buildup data, Institute of Gas Technology test data, Institute of Gas Technology sample log reservoir fluid analysis, produced gas/water ratio, chemical analysis procedures, surface flow data, third party sampling and reports, sand detectors charts and Horner-type buildup data. DOE

N81-25524# Battelle Pacific Northwest Labs Richland Wash **CANDIDATE WIND-TURBINE-GENERATOR SITE Annual Data Summary, Jan - Dec 1979**

W F Sandusky and D S Renne Mar 1981 34 p
(Contract DE-AC06-76RL-01830)
(PNL-3703) Avail NTIS HC A03/MF A01

Summarized hourly meteorological data for fifteen candidate and wind turbine generator sites are presented. These data are collected for the Department of Energy for the purpose of evaluating the wind energy potential at these sites and are used to assist in selection of potential sites for installation and testing of large wind turbines in electric utility systems. For each site data are given in eight tables and one figure. Use of information from these tables with information about specific wind turbines, should allow the user to estimate the potential for wind energy production at each site. DOE

N81-25530# Michigan Univ., Ann Arbor **EXPLORATORY ENERGY RESEARCH PROGRAM AT THE UNIVERSITY OF MICHIGAN** Progress Report, 15 May - 15 Nov 1980

W Kerr 8 Dec 1980 15 p
(Contract DE-FG02-80ER-10125)
(DOE/ER-10125/1) Avail NTIS HC A02/MF A01

A grant to the University of Michigan for an Exploratory Energy Research Program is used by Office of Energy Research

(OER) to support faculty research and graduate student research assistantships Progress on activity during the first six months of the program is described and brief status reports on 20 energy related faculty research projects in the physical engineering biological and behavioral sciences are presented DOE

N81-25537# Midwest Research Inst, Golden, Colo Solar Energy Research Inst
OCEAN ENERGY RESEARCHERS INFORMATION USER STUDY

W W Belew, B L Wood, T L Marie, and C L Reinhardt Mar 1981 124 p refs

(Contracts DE-AC02-77CH-00178, ET-77-C-01-4042)

(SERI/TR-751-752) Avail NTIS HC A06/MF A01

Results of a series of telephone interviews with groups of users of information on ocean energy systems are reported Types of information each group needed and the best ways to get information to each group are discussed Baseline data about information needs in the solar community is provided Only high priority groups were examined DOE

N81-25556# Oak Ridge National Lab, Tenn
FOSSIL ENERGY PROGRAM Progress Report, Jan. 1981
 L E McNeese Mar 1981 111 p refs
 (Contract W-7405-eng-26)

(ORNL/TM-7723) Avail NTIS HC A08/MF A01

A compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives as sources of clean energy is presented The projects reported this month include those for coal conversion development, chemical research and development materials technology, component development and process evaluation, technical support to major liquefaction projects, process analysis, and engineering evaluations, fossil energy environmental analysis, flue gas desulfurization, solid waste disposal, coal preparation and waste utilization, plant control development, atmospheric fluidized bed coal combustor for cogeneration, Tennessee Valley Authority Fluidized Bed Combustion demonstration plant program technical support, PFBC systems analysis, fossil fuel applications assessments, performance assurance system support for fossil energy projects, international energy technology assessment, and generalized equilibrium models of liquid and gaseous fuel supplies DOE

N81-25558# Los Alamos Scientific Lab, N Mex
PRELIMINARY HOT DRY ROCK GEOTHERMAL EVALUATION OF LONG VALLEY CALDERA, CALIFORNIA

David T Gambill Mar 1981 26 p refs

(Contract W-7405-eng-36)

(LA-8710-HDR) Avail NTIS HC A03/MF A01

Teleseismic data indicate a low P wave velocity zone below the western part of the caldera, indicating a magma chamber between 7 and 25 km depth This conclusion is supported by gravity data Heat flow just west of the caldera is 3.75 HFU Just east of the caldera, measured heat flow is about 2 HFU However a deep well on the eastern edge of the resurgent dome has a gradient of 380C/km from 0.66 to 1.2 km suggesting that the magma chamber, which produced Long Valley, is largely crystallized below the resurgent dome The high heat flow beneath the western caldera may be a manifestation of shallow silicic magma associated with the recent Inyo Craters These data indicate a smaller magma source may lie below the western caldera The higher temperature gradient and lack of caldera fill beyond the west margin of the caldera combine to make this area promising for future HDR evaluation DOE

N81-25568# Oak Ridge National Lab, Tenn
FOSSIL ENERGY PROGRAM Quarterly Progress Report, period ending 31 Dec 1980

L E McNeese Apr 1981 409 p refs

(Contract W-7405-eng-26)

(ORNL-5727) Avail NTIS HC A18/MF A01

Progress made during the period October 1 through December 31 for the Oak Ridge National Laboratory research and development projects carried out in support of the increased utilization of coal and other fossil fuels as sources of clean energy, is described DOE

N81-25571# TRW, Inc, McLean Va Energy Systems Planning Div

ENERGY BALANCES IN THE PRODUCTION AND END USE OF ALCOHOLS DERIVED FROM BIOMASS A FUELS-SPECIFIC COMPARATIVE ANALYSIS OF ALTERNATE ETHANOL PRODUCTION CYCLES

Oct 1980 135 p refs

(Contract DE-AC01-79PE-70151)

(DOE/PE-70151/T5 TRW-97611-E002-UX-00) Avail NTIS HC A07/MF A01

Questions of net gains in premium fuels that can be derived from the production and use of ethanol from biomass, and that for the US alcohol fuel program, energy balance need not be a concern Three categories of fuel gain are discussed in the report (1) net petroleum gain (2) net premium fuel gain (petroleum and natural gas), and (3) net energy gain (for all fuels) In this study the investment of energy (in the form of premium fuels) in alcohol production includes all investment from cultivating, harvesting, or gathering the feedstock and raw materials, through conversion of the feedstock to alcohol to the delivery to the end user DOE

N81-25581# Battelle Columbus Labs Ohio
CONSTRUCTION MATERIALS FOR WET SCRUBBERS, VOLUME 1 Final Report

H S Rosenberg H H Krause, L J Nowacki C W Kistler, J A Beavers R B Engdahl R J Dick, and J H Oxley Mar 1981 154 p refs

(EPRI Proj 982-14)

(EPRI-CS-1736-Vol-1) Avail NTIS HC A08/MF A01

Experience with materials of construction in full scale lime/limestone wet FGD systems on boilers burning eastern or western coals is documented Information was collected for the following FGD system components: prescrubbers absorbers spray nozzles, mist eliminators reheaters fans ducts, expansion joints dampers stacks, storage silos, ball mills and slakers pumps, piping and valves, tanks and thickeners agitators and rakes vacuum filters and centrifuges and pond linings Materials documentation and analysis includes successes, failures reasons for success or failure failure mechanisms and relative costs of various materials The results are designed to be a first step in aiding utilities and FGD equipment suppliers in selecting materials that will perform satisfactorily without unnecessary expense Outlet ducts downstream from the outlet dampers, stack linings prescrubbers absorbers reheaters, outlet ducts upstream of the outlet dampers dampers pumps piping and valves, spray nozzles mist eliminators fans inlet and bypass ducts, expansion joints storage silos, ball mills and slakers tanks and thickeners agitators and rakes vacuum filters and centrifuges and pond linings are all considered in terms of failure history DOE

N81-25593# Environmental Protection Agency, Ann Arbor, Mich Test and Evaluation Branch

EXHAUST EMISSIONS FROM TWENTY LIGHT DUTY DIESEL TRUCKS

John C Shelton Aug 1980 29 p ref

(PB81-153785 EPA-AA-TEB-80-20)

Avail NTIS

HC A03/MF A01 CSCL 13F

Results of an exhaust emission testing program are described Twenty diesel-powered light-duty trucks were tested Gross vehicle weight ratings for these trucks ranged from 5300 to 6200 lbs Emission factors for light duty diesel-powered trucks were developed An assessment of the emission durability of the engines and an evaluation of fuel economy are included Mass emissions were also measured during individual steady state and transient modes of operation The average emission test results were very low and similar to those from diesel engines in passenger cars Diesel engines in light duty truck service demonstrate virtually no emission deterioration while in-use over their 'useful' life although two engines required major engine rebuilding before 50,000 miles GRA

N81-25615# Utah Univ Salt Lake City Earth Science Lab
GEOPHYSICAL INVESTIGATIONS OF THE BALTAZOR HOT SPRINGS KNOWN GEOTHERMAL RESOURCE AREA AND THE PAINTED HILLS THERMAL AREA, HUMBOLDT COUNTY, NEVADA

R K Edquist Feb 1981 101 p refs

(Contract DE-AC07-79ID-12079)

04 FUELS AND OTHER SOURCES OF ENERGY

(DOE/ID-12079/29, ESL-54) Avail NTIS HC A06/MF A01
Geophysical investigations of the Baltazor Hot Springs geothermal resource area and the Painted Hills thermal area, Humboldt Co., Nevada are described. A gravity survey of 284 stations covering 750 sq km was conducted. Numerical modeling and interpretation of five detailed gravity profiles, numerical modeling and interpretation of 218 line km of dipole-dipole electrical resistivity data along four profiles and a qualitative interpretation of 38 line km of self-potential data along eight profiles are included. The primary purpose of the investigation is to try to determine the nature of the geologic controls of the thermal anomalies at the two areas. DOE

N81-25617# Los Alamos Scientific Lab., N. Mex
GEOPHYSICAL STUDY OF THE CRUST AND UPPER MANTLE BENEATH THE CENTRAL RIO GRANDE RIFT AND ADJACENT GREAT PLAINS AND COLORADO PLATEAU
Mark E. Ander. Mar 1981. 235 p refs
(Contract W-7405-eng-36)
(LA-8676-T) Avail NTIS HC A11/MF A01

As part of the national hot dry rock (HDR) geothermal program a regional deep magnetotelluric (MT) survey of Arizona and New Mexico was performed. A regional geoelectric contour map was produced of the pervasive deep electrical conductor within the crust/or upper mantle beneath the Colorado Plateau Basin and Range Province, and Rio Grande rift. An MT/audiomagnetotelluric (AMT) study of a 161 km(2) HDR prospect was performed on the Zuni Indian Reservation, New Mexico. Two dimensional gravity modeling of a 700 km gravity profile at 34030 N latitude was used to study the crust and upper mantle beneath the Rio Grande rift. DOE

N81-25618# Geological Survey, Reston, Va
SAMPLE PREPARATION OF X-RAY DIFFRACTION ANALYSIS AND CLAY MINERALOGY

John W. Hosterman and Patricia Loferski. Mar 1981. 9 p refs
(Contracts DE-AI01-76ET-10136, EX-76-C-01-2287)
(DOE/METC-2287/112) Avail NTIS HC A02/MF A01

Three well known methods of preparing the clay fraction for X-ray diffraction analysis were tested and evaluated. Kaolinite was not identified in samples prepared by the two settling methods because of layering due to differing/settling rates of the clay minerals. It is suggested that if one of the two settling methods of sample preparation is used that the clay film should be thin enough for the X-ray beam to penetrate the entire thickness of clay. The vacuum method of sample preparation is preferred. Chlorite, kaolinite, 2 M illite (muscovite), and mixed layer are the clay minerals found by X-ray diffraction analysis in Devonian shale of the Appalachian basin. The proportions of mixed layer clay minerals were determined by comparing areas of selected basal peaks on X-ray diffraction traces of untreated samples with those of samples that had been heated and saturated by ethylene glycol. DOE

N81-25619# Pennsylvania Dept of Environmental Resources
Harrisburg. Bureau of Topographic and Geologic Survey
STRATIGRAPHIC CROSS SECTION (1) OF THE UPPER DEVONIAN PERRYBURG AND JAVA FORMATIONS AND THEIR EQUIVALENTS, NORTHWESTERN PENNSYLVANIA
J. A. Harper and K. D. Abal. 1981. 25 p refs
(Contract DE-AS21-76MC-05198)
(METC/EGSP-22) Avail NTIS HC A02/MF A01

A map of the Java, Perryburg, Ohio shale and Olentangy shale formations in the Erie, Crawford, Warren, Forest, and Clarion counties of Pennsylvania is presented. The stratigraphic cross section is based on gamma ray logs. Special emphasis is placed on the organic rich, radioactive shales of these formations. DOE

N81-25639# Western Scientific Services, Inc. Fort Collins, Colo
WIND ENERGY RESOURCE ATLAS VOLUME 2. THE NORTH CENTRAL REGION
D. L. Freeman, D. L. Hadley, D. L. Elliott, W. R. Barchet, and R. L. George. Feb 1981. 191 p refs. Prepared for Battelle Pacific Northwest Labs.
(Contract DE-AC06-76RL-01830)

(PNL-3195-WERA-2-Vol-2) Avail NTIS HC A09/MF A01
The North Central atlas assimilates six collections of wind resource data: one for the region and one for each of the five states that compose the North Central region (Iowa, Minnesota,

Nebraska, North Dakota, and South Dakota). At the state level features of the climate, topography and wind resource are discussed in greater detail than is provided in the regional discussion, and that data locations on which the assessment is based are mapped. Variations over several time scales in the wind resource at selected stations in each state are shown on graphs of monthly average and international wind speed and power, and hourly average wind speed for each season. Other graphs present speed direction and duration frequencies of the wind at these locations. DOE

N81-25640# GEOMET, Inc., Gaithersburg, Md
WIND ENERGY RESOURCE ATLAS VOLUME 6. THE SOUTHEAST REGION

J. Zabransky, J. M. Vilarado, J. T. Schakenbach, D. L. Elliott, W. R. Barchet, and R. L. George. Jan 1981. 175 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3195-WERA-6-Vol-6) Avail NTIS HC A08/MF A01

The Southeast atlas assimilates six collections of wind resource data: one for the region and one for each of the five states that compose the Southeast region (Alabama, Florida, Georgia, Mississippi, and South Carolina). At the state level, features of the climate, topography and wind resource are discussed in greater detail than is provided in the regional discussion, and the data locations on which the assessment is based are mapped. Variations over several time scales in the wind resource at selected stations in each state are shown on graphs of monthly average and interannual wind speed and power, and hourly average wind speed for each season. Other graphs present speed, direction and duration frequencies of the wind at these locations. DOE

N81-25659# California Univ., Berkeley. Lawrence Berkeley Lab. Earth Sciences Div.
THERMODYNAMICS OF GEOTHERMAL FLUIDS
Ph.D. Thesis

P. S. Z. Rogers. Mar 1981. 253 p refs
(Contract W-7405-eng-48)

(LBL-12356) Avail NTIS HC A12/MF A01

A model to predict the thermodynamic properties of geothermal brines, based on a minimum amount of experimental data on a few key systems, is tested. Volumetric properties of aqueous sodium chloride taken from the literature, are represented by a parametric equation over the range 0 to 3000 C and 1 bar to 1 kbar. Density measurements at 20 bar needed to complete the volumetric description, also are presented. The pressure dependence of activity and thermal properties, derived from the volumetric equation, can be used to complete an equation of state for sodium chloride solutions. A flow calorimeter used to obtain heat capacity data at high temperatures and pressures, is described. Heat capacity measurements, from 30 to 2000 C and 1 bar to 200 bar, are used to derive values for the activity coefficient and other thermodynamic properties of sodium sulfate solutions as a function of temperature. Literature data on the solubility of gypsum in mixed electrolyte solutions are used to evaluate model parameters for calculating gypsum solubility in seawater and natural brines. Predictions of strontium and barium sulfate solubility in seawater also are given. DOE

N81-26212# Duquesne Univ., Pittsburgh, Pa. Dept of Chemistry

HYDROGEN BONDING IN ASPHALTENES AND COAL LIQUIDS Quarterly Report, 1 Feb - 30 Apr 1981

N. C. Li, L. Jones, and N. F. Yaggi. 1981. 30 p refs

(Contract DE-AC22-80PC-30252)

(DOE/PC-30252/T3 QR-3) Avail NTIS HC A03/MF A01

The nature and strength of hydrogen bonding and other molecular interactions in coal liquids and their fractions are investigated. Determinations are made of the molecular interactions involving the preasphaltene, asphaltene and oil together with their separated fractions, obtained from coal liquids after hydroprocessing under different processing conditions and accelerated aging. The upgraded coal liquids, derived from catalytic hydroprocessing of a 30 to 70 weight percent blend of solid solvent refined coal product (SRC-1) with liquid solvent-refined coal product (SRC-2) were analyzed as a function of contact time and temperature, and the observed variations of structural parameters were correlated with the physical properties of the liquid products. DOE

N81-26216# Battelle Pacific Northwest Labs Richland, Wash
THERMAL DEGRADATION OF CELLULOSE IN ALKALI
 Rachel K Miller, Peter M Molton, and Janet A Russell Dec 1980 12 p refs Presented at the 3d Miami Intern Conf on Alternative Energy Sources, Miami Beach, Fla, 15 Dec 1980 (Contract DE-AC06-76RL-01830)
 (PNL-SA-8603 CONF-801210-21) Avail NTIS HC A02/MF A01

Biomass in an alkaline aqueous slurry can be liquefied by heat and pressure Understanding the mechanisms of biomass liquefaction to improve the efficiency of converting biomass to useful product, particularly chemicals and synthetic fuels is discussed To study the chemical mechanisms of the process, pure cellulose, the main component of biomass, was liquefied The 78 cellulose liquefaction products that were identified by gas chromatography/mass spectrometry include polyols, furans, ketones, hydrocarbons and aromatic compounds Polyols may be formed by hydrogenolytic cleavage Furans and cyclic ketones employed to determine the flow fields and provide preliminary estimates of separation factors Separation factors of high accuracy were obtained using a test-particle method in which single particles were followed through the flow fields established by the Bird method Species densities, velocities and velocity distributions as well as separation factors are reported DOE

N81-26247# California Univ Berkeley Lawrence Berkeley Lab Materials and Molecular Research Div
CORROSION OF METALS IN OIL SHALE ENVIRONMENTS
 A Levy and R Bellman, Jr Dec 1980 27 p refs Presented at the Natl Assoc of Corrosion Engr Conf, Corrosion '81 Toronto 6-10 Apr 1981
 (Contract W-7405-eng-48) (LBL-12019, CONF-810402-10) Avail NTIS HC A03/MF A01

In the corrosion of mild low alloy and stainless steel in elevated temperature in-situ oil shale retorting environments was investigated The catastrophic oxidation-sulfidation attack that can occur in in-situ retorts is documented for a thermowell consisting of a mild steel pipe protecting a stainless steel sheathed thermocouple assembly The behavior of metals under a number of varying conditions such as service temperature type of shale and oil content of shale is presented The potential of coatings on mild steel to extend its service range in shale retorting environments was determined for pack aluminate type coatings DOE

N81-26272# Comptroller General of the United States, Washington D C
LIQUEFYING COAL FOR FUTURE ENERGY NEEDS
 12 Aug 1980 41 p refs
 (EMD-80-84) Avail NTIS HC A03/MF A01

The status of various coal liquefaction processes is reported Research and development, as well as commercialization efforts are surveyed Design construction, and operation of coal liquefaction projects are summarized SF

N81-26275# Computer Sciences Corp El Segundo Calif Engineering Systems Dept
THE LEWIS CHEMICAL EQUILIBRIUM PROGRAM WITH PARAMETRIC STUDY CAPABILITY
 Rene Sevigny May 1981 287 p
 (Contract NAS8-31640) (NASA-CR-161811) Avail NTIS HC A13/MF A01 CSCL 21D

The program was developed to determine chemical equilibrium in complex systems Using a free energy minimization technique the program permits calculations such as chemical equilibrium for assigned thermodynamic states theoretical rocket performance for both equilibrium and frozen compositions during expansion incident and reflected shock properties and Chapman-Jouget detonation properties It is shown that the same program can handle solid coal in an entrained flow coal gasification problem TM

N81-26276# Computer Sciences Corp El Segundo Calif Engineering Systems Dept
ADDITION TO THE LEWIS CHEMICAL EQUILIBRIUM PROGRAM TO ALLOW COMPUTATION FROM COAL COMPOSITION DATA
 Rene Sevigny Dec 1980 271 p

(Contract NAS8-31640)
 (NASA-CR-161809) Avail NTIS HC A12/MF A01 CSCL 21D

Changes made to the Coal Gasification Project are reported The program was developed by equilibrium combustion in rocket engines It can be applied directly to the entrained flow coal gasification process The particular problem addressed is the reduction of the coal data into a form suitable to the program, since the manual process is involved and error prone A similar problem in relating the normal output of the program to parameters meaningful to the coal gasification process is also addressed TM

N81-26278# Virginia Commonwealth Univ, Richmond
NEW CATALYSTS FOR THE INDIRECT LIQUEFACTION OF COAL Semiannual Technical Report
 Gordon A Melson 1981 16 p refs
 (Contract DE-FG22-80PC-30228) (DOE/PC-30228/T1) Avail NTIS HC A02/MF A01

The synthesis and characterization of two series of supported metal compounds was achieved These potentially catalytic materials were prepared from transition metal carbonyls and both simple oxide and zeolite supports by a newly developed synthetic procedure, spectroscopic and thermogravimetric techniques were employed for characterization Evaluation of the ability of some of these materials to catalyze the hydrogenation of carbon monoxide was completed Product distributions which are significantly different from those which are obtained by using conventionally prepared catalysts are produced with some of these materials DOE

N81-26280# Harvard Univ, Cambridge, Mass Energy and Environmental Policy Center
VULNERABILITY REDUCTION STUDY COAL AND SYNTHETICS SECTION 3A TECHNICAL APPENDIX
 Aug 1980 29 p refs
 (Contract DE-AC01-80PE-70278) (DOE/PE-70278/T4) Avail NTIS HC A03/MF A01

This Appendix supports and explains key statements made in the chapter on Coal and Synthetics Evidence is presented that coal supply will not be constrained by production or transportation factors through the 1980s Any program to increase the direct use of coal in the industrial sector must take into account a number of identifiable difficulties A deployment schedule for 10 oil shale projects was developed by the Office of Technology Assessment This schedule if adhered to would result in an initial deployment of an oil shale industry of 400 000 bpd oil equivalent by 1990 In addition the Appendix provides descriptions of those major elements of Federal legislation that bear directly on coal DOE

N81-26281# Arizona State Univ Tempe Dept of Chemical Engineering
INDIRECT THERMAL LIQUEFACTION PROCESS FOR PRODUCING LIQUID FUELS FROM BIOMASS
 J L Kuester 1980 24 p refs Presented at the 89th Ann Meeting of the Am Inst of Chem Engr, Portland, Oreg, 17-20 Aug 1980
 (Contract DE-AS02-76CS-40202) (COO-2981-61 CONF-800802-24) Avail NTIS HC A02/MF A01

A progress report on an indirect liquefaction process to convert biomass type materials to quality liquid hydrocarbon fuels by gasification followed by catalytic liquid fuels synthesis has been presented A wide variety of feedstocks can be processed through the gasification system to a gas with a heating value of 500 + Btu/ SCF Some feedstocks are more attractive than others with regard to producing a high olefin content This appears to be related to hydrocarbon content of the material The H₂/CO ratio can be manipulated over a wide range in the gasification system with steam addition Some feedstocks require the aid of a water-gas shift catalyst while others appear to exhibit an auto-catalytic effect to achieve the conversion H₂S content (beyond the gasification system wet scrubber) is negligible for the feedstocks surveyed The water gas shift reaction appears to be enhanced with an increase in pyrolysis reactor temperature over the range of 1300 to 1700 F DOE

N81-26282# Battelle Pacific Northwest Labs, Richland Wash
CHEMICAL COMPARISONS OF LIQUID FUEL PRODUCED BY THERMOCHEMICAL LIQUEFACTION OF VARIOUS

04 FUELS AND OTHER SOURCES OF ENERGY

BIOMASS MATERIALS

J A Russell, Peter M Molton, and Steven D Landsman Dec 1980 17 p refs Presented at the 3d Miami Intern Conf on Alternative Energy Sources Miami Beach, Fla., 17 Dec 1980 (Contract DE-AC06-76RL-01830) (PNL-SA-8602, CONF-801210-22) Avail NTIS HC A02/MF A01

Liquefaction of biomass in aqueous alkali at temperatures up to 350 C is an effective way to convert solid wastes into liquid fuels. The liquefaction oils of several forms of biomass differing in proportions of cellulose, hemicellulose, lignin, protein, and minerals were studied and their chemical composition compared. It was that the proportions of chemical components varied considerably depending on the type of biomass liquefied. However, all the oils, even those produced from cellulose, had similar chemical characteristics due to the presence of significant quantities of phenols. These phenols are at least partially responsible for the corrosivity and viscosity commonly associated with biomass oils. The differences in chemical component distribution in the various biomass oils might successfully be exploited if the oil is to be used as a chemical feedstock. If the oil is to be used as a fuel, however, then reaction conditions will be a more important consideration than the source of biomass. DOE

N81-26287# General Electric Co Schenectady, N Y Dept of Energy Systems Programs
PFB COAL-FIRED COMBINED-CYCLE DEVELOPMENT PROGRAM TEST EVALUATION REPORT. CURL TEST SERIES

1980 187 p
(Contracts DE-AC21-76ET-10377, EX-76-C-01-2357) (FE-2357-69) Avail NTIS HC A09/MF A01

Tests were performed in order to investigate corrosion and erosion of candidate gas turbine blade alloys for service in a Pressurized Fluidized Bed (PFB) combined cycle power plant. The tests also permitted an evaluation of hot gas cleanup equipment. The results are encouraging indicating that it is possible to provide materials which can withstand the erosive/corrosive PFB environment. Further, it was found that the reduction of particulate efflux via cyclones was sufficient to eliminate excessive erosion of gas turbine components in the stationary cascades tested. The tests also demonstrated the great care required to obtain accurate and consistent data measurement in certain areas. Particle size distribution data indicated a high consistency of operation. On the other hand difficulties were encountered in obtaining accurate and reliable indication of the alkali content of the exhaust gas. DOE

N81-26289# Public Technology Inc, Washington, D C
ENERGY COMPRESSED NATURAL GAS AN ALTERNATIVE VEHICULAR FUEL FOR LOCAL GOVERNMENTS (A CASE STUDY FROM THE URBAN CONSORTIUM)

1980 7 p refs
(Grant NSF ISP-78-12729) (PB81-160012, NSF/RA-800356) Avail NTIS HC A02/MF A01 CSCL 21D

Parameters in the choice of CNG as an alternative fuel including performance, engine wear, safety, environmental effects and economics are discussed. Compressed natural gas (CNG) can be burned as a substitute fuel in existing gasoline engines which have been adapted to burn CNG without losing the ability to burn gasoline. The storage tanks can be installed in the trunk of a car or on the underside of a van and are connected to the gas/air mixer, which sits on top of the carburetor, near the fuel line/regulator assembly. The operator of the vehicle can switch to CNG from gasoline (or vice versa) by a control switch on the dashboard. GRA

N81-26532# CER Corp, Las Vegas, Nev
WESTERN GAS SANDS PROJECT UPPER CRETACEOUS AND LOWER TERTIARY STRATIGRAPHY AND NATURAL GAS POTENTIAL OF THE GREATER GREEN RIVER BASIN OF WYOMING

H E Newman III comp 2 Apr 1981 38 p refs
(Contract DE-AC08-79BC-10003) (DOE/BC-10003/20) Avail NTIS HC A03/MF A01

Major reserves of natural gas remain to be discovered in the Greater Green River Basin of southwestern Wyoming and northwestern Colorado. This basin, occupying approximately

21,000 square miles, includes four sub-basins. These are the Green River Basin proper, west of the Rock Spring Uplift, and the Red Desert Washakie, and Sand Wash Basins, on the east side of the uplift. Thick sections of Tertiary and Upper Cretaceous rocks exist throughout most parts of the Greater Green River Basin. Drilling depths to penetrate these sections range from relatively shallow depths on the flanks of the individual basins to depths greater than 20,000 ft in certain areas of the Green River Basin proper. DOE

N81-26539# West Virginia Univ Morgantown Dept of Geology and Geography

STRATASPECIFIC GEOCHEMICAL TREND MAPS FOR EASTERN KENTUCKY, APPENDIX Final Report

J Negus-deWys Apr 1981 175 p
(Contract DE-AC21-76ET-12138) (DOE/ET-12138/T2) Avail NTIS HC A08/MF A01

Strataspecific geochemical trend maps representing the contouring of data obtained by X-ray fluorescence and X-ray diffraction analyses of upper Devonian well cuttings from 14 wells in the Big Sandy Gas Field in Kentucky are presented. DOE

N81-26541# Alaska Univ Fairbanks Geophysical Inst
REVIEW OF TECHNOLOGY FOR ARCTIC OFFSHORE OIL AND GAS RECOVERY VOLUME 2 APPENDICES

W M Sackinger 6 Jun 1980 943 p refs
(Contract DE-AC01-80ET-14317) (DOE/ET-14317/T2-Vol-2) Avail NTIS HC A03/MF A01

The US Geological Survey Arctic operating orders 1979 Det Norske Veritas' rules for the design, construction and inspection of offshore technology 1977 Alaska Oil and Gas association, industry research projects March 1980 and Arctic Petroleum Operators Association, industry research projects January 1980 are presented. A selected additional Arctic offshore bibliography on sea ice icebreakers, Arctic seafloor conditions ice-structures frost heave and structure icing is included.

N81-26567# Geological Survey, Denver Colo
COLORADO GEOTHERMAL COMMERCIALIZATION PROGRAM GEOTHERMAL ENERGY OPPORTUNITIES AT FOUR COLORADO TOWNS. DURANGO, GLENWOOD SPRINGS, IDAHO SPRINGS AND OURAY

Barbara A Coe and Judy Zimmerman Jan 1981 66 p refs
(Contract DE-FC07-79ID-12018) (DOE/ID-12018/8) Avail NTIS HC A04/MF A01

The first area of investigation was the site itself its geographic, population, economic energy demand characteristics and the attitudes of its residents relative to geothermal development potential. Secondly, the resource potential is described to the extent it is known along with information concerning any exploration or development that was conducted. The third item investigated was the process required for development. There are financial, institutional, environmental, technological and economic criteria for development that must be known in order to realistically gauge the possible development. Planned, proposed and potential development are all described, along with a possible schedule for that development. An assessment of the development opportunities and constraints are included. DOE

N81-26570# Theisen (Phillip), Madison, Wis
LOW COST PROCESS HEAT RECOVERY Interim Report

Phillip Theisen and James McCray 1980 32 p refs
(Contract DE-FG02-80R5-10251) (DOE/R5-10251/1) Avail NTIS HC A03/MF A01

Waste heat is analyzed in terms of recovery potential, economics, heat exchanger and system design and computer programs. The heating demand and heat recovery potential at a neighborhood bakery was assessed. The feasibility of waste heat recovery systems is analyzed using life cycle cost and life cycle savings. For a first approximation, hand calculations were performed for air-to-air flat plate fin plate, and liquid-to-air tube type heat exchangers using the temperature and mass flow data from a pizza restaurant in Madison. Then a heat exchanger analysis program was written in interactive BASIC. The analysis indicates that heat recovery using the flat plate and fin plate exchanger designs is technically feasible and yields high effectiveness. DOE

N81-26573# Hira (W A) and Associates, Inc., Hilo, Hawaii **HYDROELECTRIC POWER IN HAWAII. A REPORT ON THE STATEWIDE SURVEY OF POTENTIAL HYDROELECTRIC SITES**

Curtis A Beck Feb 1981 107 p refs
(Contract DE-FC49-80R9-10031)

(DOE/R9-10031/T1) Avail NTIS HC A06/MF A01

The major conclusion is that hydropower resources in the State of Hawaii are substantial, and they offer the potential for major increases in hydropower generating capacity. Hydropower resources on all islands total about 50 MW of potential generating capacity. Combined with the 18 MW of existing hydropower capacity, hydropower resources potentially could generate about 307 million kWh of electric energy annually. This represents about 28% of the present combined electricity needs of the Neighbor Islands, Kauai, Molokai, Maui, and the Big Island. Hydropower resources on Kauai equal 72% of that island's electricity needs, on Molokai, 40% on the Big Island, 20% and on Maui, 18%. DOE

N81-26576# California Univ Berkeley Lawrence Berkeley Lab

NUMERICAL STUDIES OF THE ENERGY SWEEP IN FIVE-SPOT GEOTHERMAL PRODUCTION/INJECTION SYSTEMS

M J O'Sullivan and K Pruess Dec 1980 11 p refs Presented at 6th Ann Workshop on Geothermal Reservoir Engr Stanford Calif, 16 Dec 1980

(Contract W-7405-eng-48)

(LBL-12166 CONF-801233-5) Avail NTIS HC A02/MF A01

A vapor dominated, single layer reservoir is considered, next a vapor dominated, four layer reservoir and finally a liquid dominated, single layer reservoir. In each case varying injection rates are considered and in some cases the injection is changed at different times. The SHAFT9 simulator was used to calculate the reservoir behavior in each case. The calculations are made for a five spot configuration of alternate, off-set rows of producers and injectors. A calculation mesh with 34 nodes is used, which is barely sufficient to give accurate results. In fact some of the results exhibit small oscillations with time due to this relatively coarse discretization. DOE

N81-27241# Sandia Labs Albuquerque N Mex

CATALYSTS IN COAL LIQUEFACTION

M G Thomas 1981 10 p refs Presented at the 8th Energy Tech Conf and Exposition Washington DC 9 Mar 1981

(Contract DE-AC04-76DP-00789)

(SAND-80-1751C) Avail NTIS HC A02/MF A01

It is not clear that conventional hydrodesulfurization or hydrodenitrogenation is paramount for the early stages of coal liquefaction, although they are clearly required in upgrading. Other catalysts may be much more effective in transferring hydrogen from the solvent to the coal-derived products. Catalysts are used but are not absolutely necessary for direct coal liquefaction. Current technology utilizes catalysts primarily for upgrading and refining relying on thermal chemistry for most of the initial reaction. Major process modifications due to catalysis are not likely under this constraint. In the absence of this limitation the effects that catalysts have on the initial chemistry of coal liquefaction could be utilized and these effects could provide significant process improvements. DOE

N81-27245# Energy and Environmental Research Corp Santa Ana Calif

ASSESSMENT OF PULVERIZED-COAL-FIRED COMBUSTOR PERFORMANCE Quarterly Technical Progress Report

W Richter, W Clark and R Payne Apr 1981 38 p refs

(Contract DE-AC22-80PC-30297)

(DOE/PC-30297/T3, QTPR-2) Avail NTIS HC A03/MF A01

The objective of this program is to provide the engineering tools necessary for an authoritative assessment of the performance of industrial furnaces firing pulverized coal. The program incorporates two experimental tasks and is constructed around an analytical task (Task 1) which will identify and upgrade the family of computer programs required to undertake the performance analysis studies. These analytical tools will be used on combustor performance and to identify those properties which have a major impact on thermal performance. The second task used a combustion reactor to screen the key variables identified

in Task 1 and to provide data on the properties of coal particulate matter which affect heat transfer performance DOE

N81-27246# Energy and Environmental Research Corp Santa Ana Calif

ASSESSMENT OF PULVERIZED-COAL-FIRED COMBUSTOR PERFORMANCE MODELS FOR COAL COMBUSTOR PERFORMANCE ANALYTICAL TOOL VERIFICATION

W Richter Feb 1981 96 p refs

(Contract DE-AC22-80PC-30297)

(DOE/PC-30297/T2) Avail NTIS HC A05/MF A01

The development of mathematical models that describe the complex heat transfer processes which occur in industrial combustion chambers is discussed. These combustor models are grouped as either pure heat transfer models or as coupled fluid flow combustion, and heat transfer models. Two models of the first type and one of the second type are described together with some basic assumptions and sample problems which illustrate their major features and capabilities. DOE

N81-27248# Karlsruhe Univ (West Germany) Engler-Bunte Inst

CATALYSTS AND RELATIONS OF SELECTIVITY FOR FISCHER-TROPSCH SYNTHESIS Final Report

Hans Schulz Bonn Bundesministerium fuer Forschung und Technologie Nov 1980 128 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-124 ISSN-0340-7608)

BMFT-03E1174A/ETS0004A) Avail NTIS HC A07/MF A01

As a basis for desired alterations of product selectivity the interrelations of selectivity in the Fischer-Tropsch system with cobalt and with iron catalysts are described as a function of temperature, synthetic gas composition, pressure, residence time, and type of process. An important role in this connection is attributed to analytical methods for determining product composition and to the characteristics of product selectivity (product distribution to fractions of same carbon number, methane formation, olefin portion of the hydrocarbons, olefin isomerization, skeletal isomerization, formation of alcohols). Interrelations and limitations of selectivity are evaluated in detail. Author (ESA)

N81-27258*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

MATERIAL RESPONSE FROM MACH 0.3 BURNER RIG COMBUSTION OF A COAL-OIL MIXTURE

G J Santoro, F D Calfo, and F J Kohl Jun 1981 24 p refs

(Contract EF-77-A-01-2593)

(NASA-TM-81686 DOE/NASA/2593-23 E-718) Avail NTIS HC A02/MF A01 CSCL 11F

Wedge shaped specimens were exposed to the combustion gases of a Mach 0.3 burner rig fueled with a mixture of 40 weight percent micron size coal particles dispersed in No. 2 fuel oil. Exposure temperature was about 900 C and the test duration was about 44 one hour cycles. The alloys tested were the nickel base superalloys IN-100, U-700 and IN-792 and the cobalt base superalloy Mar-M509. The deposits on the specimens were analyzed and the extent of corrosion/erosion was measured. The chemical compositions of the deposits were compared with the predictions from an equilibrium thermodynamic analysis. The experimental results were in very good agreement with the predictions. Author

N81-27262# Idaho National Engineering Lab Idaho Falls **EFFECT OF FOUR SIMULATED COAL GASIFIER ATMOSPHERES ON THE BIAXIAL STRESS RUPTURE BEHAVIOR OF FOUR CANDIDATE COAL GASIFIER ALLOYS**

R M Horton 1980 34 p refs Presented at the Am Soc of Metals Conf Pittsburgh 28 Oct 1980

(Contract DE-AC07-76ID-01570)

(CONF-8010162-1) Avail NTIS HC A03/MF A01

Tests were conducted on four alloys (Type 310 stainless steel, Incoloy 800H, Haynes 188 and IN-657) which are candidates for use in coal gasifiers to determine whether their hundred hour biaxial stress rupture strength and life were adversely affected by exposure to four simulated coal gasifier atmospheres. Exposure to these atmospheres at temperatures below 1172 K (1650 F) did not decrease these rupture properties below

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measured in air Only at 1255 K (1800 K) were the rupture properties in the various atmospheres consistently below those measured in air at atmospheric pressure Corrosion coupon tests of Inconel 600 Incoloy 800 and Type 309 stainless steel in CGA verified data obtained from similar tests by other laboratories DOE

N81-27264# Ad-Ex International, Portola Valley Calif PROCESS FOR THE EXTRACTION OF HEAVY METALS DISSOLVED IN SEAWATER

Dieter Heitkamp and Klaus Wagener Feb 1981 26 p Transl into ENGLISH of West German Patent no 2711609 (17 Mar 1977)

(Contract W-7405-eng-48)

(UCRL-Trans-11677) Avail NTIS HC A03/MF A01

A process is claimed for the extraction of heavy metals, particularly uranium which are dissolved in seawater The heavy metals are concentrated by adsorption on a matrix materials of natural black peat The procedure involves the following steps adsorber matrix of black peat containing a biologically recent humic acid and having a maximum of 90% by weight of material serving as the carrier material for the humic acid is placed in contact with seawater until as high a proportion as possible of heavy metals are adsorbed adsorber matrix is removed from seawater and the heavy metals are extracted with dilute hydrochloric acid which is made by the electrolytic decomposition of sodium chloride in the seawater, the extract is adjusted to a pH range of 4 to 8 with hydroxide which is also prepared by the electrolytic decomposition of sodium chloride in the seawater the eluate is treated again with an adsorber matrix containing humic acid for further concentration of the heavy metals, and the metals are finally processed off as metal salts DOE

N81-27273 British Library Lending Div Boston Spa (England) TENSIDES AND POLYMERS AGENTS FOR TERTIARY RECOVERY OF CRUDE OIL IN HIGHLY SALINE SYSTEMS

M Akstinat Nov 1980 29 p refs Transl into ENGLISH of Tenside Detergents (West Germany), v 17 no 1 1980 p 1-9 (BLL-RTS-12452) Avail British Library Lending Div Boston Spa England

The importance and necessity for tertiary crude oil recovery processes are discussed in relation to economic factors The development and characterization of viscous flooding media for use in oil recovery are described EDK

N81-27303# Exxon Research and Engineering Co Florham Park NJ

EDS COAL-LIQUEFACTION PROCESS DEVELOPMENT. PHASE 5 EDS COMMERCIAL PLANT STUDY DESIGN UPDATE, OFFSITE DESIGN BASIS-WYOMING COAL CASE

Jan 1981 83 p refs

(Contract DE-AB01-77ET-10069)

(FE-2893-60) Avail NTIS HC A05/MF A01

The development of the Wyoming Coal Case as a sensitivity to locating a commercial Exxon donor solvent plant in a northeast Wyoming location using the once through liquefaction mode is discussed Operating conditions in liquefaction are 840 F, 60 minutes nominal residence time at a solvent to coal ratio of 1 6/1 The Wyoming Coal Case utilizes partial oxidation of about one half of the vacuum pipestill bottoms for hydrogen generation and flexicoking of the remaining bottoms to make low Btu gas for use as plant fuel The methane/ethane product will be sold as high Btu gas (HBG) The offsite design effort is concentrated on the water fuel steam and power systems and the wastewater treating facilities and product shipping facilities DOE

N81-27304# Exxon Research and Engineering Co Florham Park NJ

EDS COAL-LIQUEFACTION PROCESS DEVELOPMENT PHASE 5 EDS COMMERCIAL PLANT STUDY DESIGN UPDATE, ILLINOIS COAL EXECUTIVE SUMMARY

Feb 1981 27 p refs

(Contract DE-AB01-77ET-10069)

(FE-2893-61-Summ) Avail NTIS HC A03/MF A01

The conceptual, or study design of an Exxon Donor Solvent (EDS) Coal Liquefaction Commercial Plant feeding Illinois No 6 bituminous coal is presented The EDS process directly converts coal to a range of clean hydrocarbon products This is accomplished by contacting the coal with hydrogen in the presence of a

hydrogenated solvent at about 840 F and 2000 psi The technical and economic issues which might be faced if an EDS commercial sized plant were to be designed on Illinois coal are explored

DOE

N81-27305# Catalytic, Inc Wilsonville, Ala SOLVENT REFINED COAL (SRC) PROCESS OPERATION OF SOLVENT REFINED COAL PILOT PLANT, WILSONVILLE, ALABAMA Quarterly Technical Progress Report, Jan - Mar 1980

Feb 1981 142 p refs

(Contract DE-AC01-76ET-10154)

(FE-2270-72) Avail NTIS HC A07/MF A01

Two coals from the Kentucky 9 seam (Lafayette mine and Dotiki mine) were processed Hydrogen consumption, coal conversion and SRC yield were comparable when these coals were tested under similar conditions Process solvent quality improved after the feed was switched from Lafayette to Dotiki coal A vertical leaf filter was used for solids separation during most of the Lafayette coal operations Using solution annealed screens in the vertical leaf filter has eliminated the corrosion related screen failures previously encountered Cresol-insoluble material was very low, but ash in the filtered SRC product consistently exceeded the 0 16 wt percent specification The high ash SRC product appears to have resulted from the presence of sodium carbonate which was added to the coal slurry to prevent corrosion in the solvent recovery system Recovery of SRC in the CSD unit ranged from 78 to 82 wt percent Deashing solvent losses averaged 4 9 wt percent of the CSD feed DOE

N81-27306# Catalytic Inc Wilsonville, Ala SOLVENT REFINED COAL (SRC) PROCESS OPERATION OF SOLVENT REFINED COAL PILOT PLANT, WILSONVILLE, ALABAMA Quarterly Technical Progress Report, Apr - Jun 1980

Mar 1981 149 p refs

(Contract DE-AC01-76-ET-10154)

(FE-2270-74) Avail NTIS HC A07/MF A01

The operating conditions and test results obtained at the six-ton-per-day Solvent Refined Coal (SRC) pilot plant in Wilsonville Alabama are summarized The objectives of operations were to determine the effect of high pressure separator operation changes to vacuum column operating temperature light SRC addition and chlorine content of coal on corrosion DOE

N81-27309# Colorado State Univ Fort Collins EVALUATION OF METHANE PRODUCTION FROM WET STILLAGE AND THE NUTRITIONAL VALUE OF THE RESIDUE Final Report

G M Ward and Vince Murphy Jan 1981 35 p refs Sponsored by Midwest Research Inst

(Contracts DE-AC02-77CH-00178 EG-77-01-4042)

(SERI/TR-09076-1) Avail NTIS HC A03/MF A01

Wet stillage was obtained from a farm still that used both corn and milo as feedstocks The mash was passed through the still and the stillage was run through a screw press which resulted in two streams a solid fraction containing about 38 percent solids and a thin stillage fraction containing 5 percent silo Methane production was evaluated in a laboratory fermenter of 1-L capacity for samples of the solid fraction and for one sample of the thin stillage The original stillage and the residue remaining after methane digestion were evaluated as livestock feed by means of the standard in vitro dry matter digestibility method (IVDMD) Methane represented 50 to 70 percent of the gas production Methane production ranged from 300 to 500 L/kg of solids after fermenting 22 to 24 days and was essentially the same whether crop or milo was the feedstock One sample of thin stillage performed similar to the solid fraction on dry matter basis The IVDMD of the original stillage averaged 53 percent, while the residue after methane digestion was only 12 percent DOE

N81-27312# Worcester Polytechnic Inst Mass KINETICS AND MECHANISMS OF CATALYTIC HYDROLI- QUEFACTION AND HYDROGASIFICATION OF LIGNITE Final Technical Report

Alvin H Weiss Wilmer L Kranich Kemal Geureuz Athanasios Foutsitzas, Charles A Dyke and Paolo Rambelli 1981 129 p refs

(Contract DE-AS22-77ET-10618)

(DOE/ET-10618/T2) Avail NTIS HC A07/MF A01

A high pressure, continuous stirred-tank reactor system was constructed for the study of the catalytic liquefaction of North Dakota lignite slurried in anthracene oil. The conversion of lignite using a cobalt-molybdenum on alumina catalyst and the distribution of products as preasphaltenes, asphaltenes oil and gases studied at the following conditions: temperature 375 to 4400 C pressure 1000 to 1600 psig agitator speed, 800 to 1500 rpm catalyst concentration 0 to 10% (based on lignite) initial lignite concentration, 5 to 30% and space time, 16 to 52 minutes. In the presence of catalyst the oil yield was increased even under conditions where the catalyst did not affect overall lignite conversion. Under the most favorable conditions the oil yield was little better than that obtained by Cronauer in the uncatalyzed hydrolquefaction of subbituminous coal at similar temperature and pressure. DOE

N81-27313# Wisconsin Univ - Madison

USE OF ALCOHOL IN FARMING APPLICATIONS: ALTERNATIVE FUELS UTILIZATION PROGRAM

G L Borman Nov 1980 26 p

(Contracts DE-AC02-79CS-55025, DE-AC05-79CS-56051)

(DOE/CE-50025/1) Avail NTIS HC A03/MF A01

The use of alcohol with diesel fuel was investigated as a means of extending diesel fuel supplies. The ability to use ethanol in diesel powered farm equipment could provide the means for increasing the near term fuels self sufficiency of the American farmer. In the longer term the potential availability of methanol (from coal) in large quantities could serve to further decrease the dependency on diesel fuel. This document gives two separate overviews of the use of alcohols in farm equipment. Part one of this document compares alcohol with No 1 and No 2 diesel fuels and describes several techniques for using alcohol in farm diesel. Part two of this document discusses the use of aqueous ethanol in diesel engines spark ignition engines and provides some information on safety and fuel handling of both methanol and ethanol. DOE

N81-27314# Mitre Corp McLean Va Metrek Div

IMPACT OF DEVELOPING TECHNOLOGY ON INDIRECT LIQUEFACTION

David Gray, Milton Lytton Martin Neuworth and Glen Tomlinson Nov 1980 252 p refs

(Contracts DE-AC01-77ET-10280 EF-77-C-01-2783)

(DOE/ET-10280/T2 MTR-80W326) Avail NTIS HC A12/MF A01

The status of commercial technology for indirect liquefaction, as exemplified by SASOL facilities in South Africa, reviewed. The impact of substituting more advanced gasifiers and synthesis systems is investigated. Slagging BGC/Lurgi, Texaco and Shell-Koppers gasifiers were substituted for the Dry Ash Lurgi units used at SASOL. SASOL SYNTHOL synthesis units were replaced by slurry phase Fischer-Tropsch units employing technology pioneered by Kolbel. The advanced systems were found to have a highly favorable impact on plant efficiency, product distribution and gasoline cost. DOE

N81-27315# Los Alamos Scientific Lab N Mex

LASER SIMULATION OF SOLAR PYROLYSIS AND GASIFICATION USING STATIC COAL SAMPLES

Willard H Beattie Apr 1981 22 p refs

(Contract W-7405-eng-36)

(LA-8617) Avail NTIS HC A02/MF A01

Coal gasification by rapid radiant heating has been investigated in a controlled laboratory environment. The goals of this research were to test the feasibility of solar-driven coal gasification and to understand the conditions that control product gas yields. A technique using a CO2 laser was developed for small-scale simulation of concentrated sunlight. The effects of parameters such as radiant flux heating time and pressure on coal pyrolysis and on the reaction between char and CO2 were investigated. Good yields of medium Btu gas may be produced by pyrolysis of subbituminous coal and gasification of the resultant char in a solar flux of at least 250 W/cm². The data reported here will be useful in the design of any larger scale engineering tests of these concepts. DOE

N81-27316# Development Planning and Research Associates Inc Manhattan Kans

FEASIBILITY OF CONVERTING A SUGAR BEET PLANT TO FUEL ETHANOL PRODUCTION

Geneva S Hammaker Harry B Pfost, Milton L David and Mary Lou Marino Apr 1981 228 p refs

(Contract DE-AC02-80CS-80010)

(DOE/CS-83010/T1) Avail NTIS HC A11/MF A01

This study was performed to assess the feasibility of producing fuel ethanol from sugar beets. The potential feedstocks assessed included sugar beets, corn hybrid beets and potatoes. Markets were assessed for ethanol and fermentation by products saleability. Investment and operating costs were determined for each prospective plant. Plants were evaluated using a discounted cash flow technique to obtain data on full production costs. Environmental, health, safety and socio-economic aspects of potential facilities were examined. Three consulting engineering firms and 3 engineering construction firms are considered capable of providing the desired turn key engineering design and construction services. It was concluded that the project is technically feasible. DOE

N81-27317# Scottsbluff-Gering Payroll Development Foundation Inc, Scottsbluff Nebr

STUDY OF THE PRODUCTION OF ETHANOL FROM SUGAR BEETS FOR USE AS A MOTOR FUEL

Final Report, 1 Feb 1980 - 30 Apr 1981

Herschel W Baird 27 Apr 1981 41 p

(Contract DE-AC02-80CS-83010)

(DOE/CS-83010-1) Avail NTIS HC A03/MF A01

The decision was made to use Great Western Sugar Company's plant at Mitchell as the example plant. This plant was selected primarily on the basis of its independence from other plants and the availability of relatively nearby beet acreage. The potential feedstock assessed included sugar beets, corn hybrid beets, and potatoes. Markets were assessed for ethanol and fermentation by products saleability. Investment and operating costs were determined for each prospective plant. Plants were evaluated using a discounted cash flow technique to obtain data on full production costs. Environmental, health safety and socio-economic aspects of potential facilities were examined. Three consulting engineering firms and three engineering construction firms are considered capable of providing the desired turn key engineering design and construction services. It was concluded that the project is technically feasible. DOE

N81-27319# Sandia Labs, Albuquerque N Mex Geo-Energy Technology Dept

CATALYTIC EFFECTS IN COAL GASIFICATION

Annual Report

T D Padrick Apr 1981 29 p, refs

(Contract DE-AC04-76DP-00789)

(SAND-81-0282) Avail NTIS HC A03/MF A01

The effects of mineral matter on the devolatilization of coal and subsequent char gasification are discussed. A basis set of five Eastern bituminous coals whose mineral matter content ranged from < 5 percent to > 20 percent, but which are similar in rank and petrographic analysis was selected. The gasification rates were measured in one atmosphere of H2 at 6000C, 8000C and 10000C. No correlation was found between gasification rate and mineral matter or petrographic analysis, but a correlation was found between the gasification rates and the rank or structure of the coal. It was found that pyrite increased the gasification rates of a low-ash coal and a demineralized high-ash coal. Product gas analysis showed that the addition of pyrite primarily increased the production of CO and CH4. DOE

N81-27322# PEDCo-Environmental Inc, Cincinnati Ohio

SUMMARY OF COAL-BASED SYNTHETIC FUEL INITIATIVES

Final Report, Jun - Nov 1980

J Carvitti M Szabo and W Kemner Feb 1981 45 p refs

(Contract EPA-68-02-3173)

(PB81-168742 PN-3450-21, EPA-600/7-81-023)

EPA-600-13) Avail NTIS HC A03/MF A01 CSCL 21D

The status of demonstration and commercial-scale plants for the production of coal-based synthetic fuels through quasification and liquefaction is investigated. Data on the scope of this emerging industry, funding sources, products, and costs were obtained by reviewing current literature and contacting the primary vendors or licensors of the processes found. Of the 88 synthetic fuel projects identified, 66 represent gasification processes (29 for the production of low-Btu gas and 37 for the

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production of high-Btu gas) and 22 represent liquefaction processes. Tabulations show sponsors, production capacity, estimated production costs scale, type of coal involved, feed rate of coal, capital cost, and operating and maintenance costs
GRA

N81-27444# Oak Ridge National Lab Tenn Energy Div **HEAT PUMP CONCEPTS FOR INDUSTRIAL USE OF WASTE HEAT**

H Perez Blanco May 1981 75 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7655) Avail NTIS HC A04/MF A01

Heat pump systems for recovering waste heat are considered. A definition of performance based on the Second Law of Thermodynamics is presented. A high grade heat actuated cycle that uses a steam ejector and through residual heat actuated heat pumps are analyzed. A turbine compressor heat pump is presented that can attain relatively high delivery temperatures. The other two residual heat actuated concepts presented are absorption heat pumps. One operates on a closed cycle and the other on an open cycle. The open cycle operates with lower waste heat temperatures than a closed cycle and during the heating season it may provide both process and space heat.
DOE

N81-27595# Sandia Labs Albuquerque N Mex **ENHANCED OIL RECOVERY BY THERMAL METHODS** H M Stoller 1981 15 p refs Presented at the 8th Energy Tech Conf and Exposition Washington DC 9 Mar 1981 (Contract DE-AC04-76DP-00789) (SAND-81-0444C CONF-810315 2) * Avail NTIS HC A02/MF A01

A variety of opinions exist on the future of thermal oil recovery processes are explored ranging from a pessimistic view that they are a diminishing factor because the best reservoirs for thermal floods have already been exploited to the optimistic based on the availability of resources the gaining of experience the increasing in prices and the development of new technologies. The US and the world have tremendous of heavy oil for which thermal methods may be the only recovery process. The need exists to develop this capability and if successful the impact on availability of hydrocarbons will be great.
DOE

N81-27630# Oak Ridge National Lab Tenn **DESIGN OF THE ATMOSPHERIC FLUIDIZED-BED COAL COMBUSTOR FOR COGENERATION GAS-TURBINE SYSTEM**

R S Holcomb P A Berman and R L Gorrell 1981 10 p refs Presented at the ASME Gas Turbine Conf, Houston, Tex 9 Mar 1981 Prepared in cooperation with Westinghouse Electric Corp Concordville Penna and Babcock and Wilcox Co, Barberton Ohio
(CONF-810309-9) Avail NTIS HC A02/MF A01

The development of the technology to provide a source of high temperature air for power generation for process heating in industrial plants. The program is directed toward systems in the size range of 5 to 50 MW(e). The major effort in the program is the design of a generic reference plant cogeneration system and the design and construction of a test system that will incorporate the salient features of the reference plant.
DOE

N81-27638# Tudor Engineering Co San Francisco Calif **SIMPLIFIED METHODOLOGY FOR ECONOMIC SCREENING OF POTENTIAL LOW-HEAD SMALL-CAPACITY HYDRO-ELECTRIC SITES** Final Report, May 1979 - Aug 1980

H M Brown Jan 1981 229 p refs
(EPRI-EM-1679) Avail NTIS HC A11/MF A01

A simplified methodology for economics screening of potential low-head small capacity sites is presented in the form of a manual which permits a first level analysis to be made of a potential hydroelectric power site. Step-by-step procedures are described to assist personnel with a limited technical background to estimate the power and energy output and the project cost for a potential site and to perform a preliminary economic analysis. Two procedures are described one rapid and simplified and the other more detailed to provide for the variability inherent in hydroelectric site development. Background description are provided to assist those unfamiliar with hydroelectric practice. The manual covers plant capacities ranging from 200 to 15 000 kilowatts and a head range of 6 to 200 feet.
DOE

N81-27650# Sandia Labs Albuquerque, N Mex **GEOTHERMAL STUDIES AT KIRTLAND AIR FORCE BASE, ALBUQUERQUE, NEW MEXICO**

Linda Riddle and Bob Grant May 1981 47 p refs
(Contract DE-AC04-76DP-00789)
(SAND-81-0852) Avail NTIS HC A03/MF A01

New Mexico has geologic characteristics favorable for geothermal energy utilization. Local heat flow and geochemical studies indicate a normal subsurface temperature regime. The alluvial deposits however extend to great depths where hot fluids, heated by the normal geothermal gradient could be encountered. Two potential models for tapping geothermal energy are presented: the basin model and the fault model.
DOE

N81-27658# Applied Physics Lab Johns Hopkins Univ Laurel Md

FACT SHEETS RELATING TO USE OF GEOTHERMAL ENERGY IN THE UNITED STATES

Dec 1980 284 p refs
(Contract DE-AI01-79ET-27025)

(DOE/ET-27025/T1) Avail NTIS HC A13/MF A01

A compilation of data relating to geothermal energy in each of the 50 states is presented. The data are summarized on one page for each state. Following the summary data sheet are additional data on the geology of each state pertaining to possible hydrothermal/geothermal resources. A list of some of the reports available pertaining to the state and state energy contacts is included.
DOE

N81-27688# NEUS Inc Santa Monica Calif **BIOSOURCES DIGEST, JOURNAL ON BIOMASS UTILIZATION, VOLUME 2, NUMBER 4**

Harry Sobel Oct 1980 58 p refs
(Grant NSF PFR-77-12500)

(PB81-167058, NSF/RA-800383-Vol-2-No-4) Avail NTIS HC A04/MF A01 CSCL 10A

The journal serves as an information exchange in biomass utilization for food energy chemicals and materials. The following papers are presented in this issue: Energy and Forestry in Canada; Comparative Activity Profiles of Thielavia Terrestris and Trichoderma reesei; Cellulases; Biogas; The Chinese Experience; Introduction to the Botany 1980 Symposium; Plants and Energy and Biomass for Energy Potentials in Arizona. Grant awards publications received, recent publications, pertinent patents and forth coming meetings are noted.
GRA

N81-27764# Hawaii Univ Honolulu Dept of Meteorology **WIND ENERGY RESOURCE ATLAS VOLUME 2 HAWAII AND PACIFIC ISLANDS REGIONS**

T A Schroeder A M Horn, D L Elliott, W R Barchet and R L George Feb 1981 127 p refs
(Contract DE-AC06-76RL-01830)

(PNL-3195-WERA-11) Avail NTIS HC A07/MF A01

Introductory and background information and assessments of the wind resource in each division of the region is provided. Background on how the wind resource is assessed and on how the results of the assessment should be interpreted is presented. An introduction and outline to the descriptions of the wind resource for each division are also provided. Much of the information in the division chapters is given in graphic or tabular form.
DOE

ENERGY CONVERSION

Includes photovoltaic, thermoelectric, geothermal, ocean thermal and wind energy conversion. Also includes nuclear reactors and magnetohydrodynamic generators

A81-30905 The influence of electron capture in gaps on the efficiency of the magneto electrostatic trap E E Iushmanov (Akademiya Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR) *Nuclear Fusion*, vol 21, Mar 1981, p 329-337 11 refs Translation

Consideration is given to Coulomb electron capture in gaps between windings in the magneto electrostatic trap fusion reactor. The rate of the collisional capture of transit electrons moving from the plasma to the plugging electrodes outside the plasma and back is calculated, and conditions for neutralizing the effects of Coulomb capture on reactor power gain are established in terms of the gap depth along the magnetic field. It is shown that in order to keep the gaps free of electrons, an artificial pumping out mechanism must be used which is selective for trapped electrons. It is pointed out, however, that even if a suitable pumping mechanism were available and the gap depth were optimal, instabilities developing within the gap would be just as serious as instabilities in the transitional sheath which surrounds the nonmagnetized plasma A L W

A81-30427 Deformation and break-up of a liquid metal drop moving across a non uniform magnetic field J S Walker (Illinois, University, Urbana, Ill.) In *Developments in theoretical and applied mechanics Volume 10 - Proceedings of the Tenth Southeastern Conference* Knoxville, Tenn., April 17, 18, 1980 Knoxville, Tenn., University of Tennessee, 1980, p 89-98 6 refs Research supported by the U.S. Department of Energy, NSF Grant No. ENG 78 20146

This paper treats the deformation and break up of a liquid metal drop moving at high velocity across a non uniform magnetic field. This problem arises in the design of a fusion reactor diverter in which a cloud of liquid lithium drops moves at high velocity across magnetic field lines and collects the energy in high energy ions moving along the field lines. When a drop is entering the magnetic field, it deforms into a cigar shape along the field lines, when it is traveling across the central, uniform magnetic field region, it is undeformed, when it is leaving the magnetic field, it deforms into a discus shape with its axis parallel to the field lines. The drop breaks up when the pressure at a point in the drop is reduced to the liquid's vapor pressure (Author)

A81-30926 Control of trapped electron instability by a modulated neutral beam M Ghassemi and A K Sen (Columbia University, New York, N.Y.) *Plasma Physics*, vol 23, Apr 1981, p 273-282 9 refs NSF Grant No. ENG-74-10444-A01

The possibility of controlling the trapped electron instability in tokamaks by the use of a modulated neutral beam is investigated. Modulation of the beam is accomplished by a signal which is proportional to density fluctuations due to the trapped electron instability. Different modes of injection are investigated and oblique injection is found to be the best mode of injection. Particle input but not momentum input is found to be sufficient for control purposes (Author)

A81-31197 Simulation of hourly wind speed and array wind power K C Chou (Harza Engineering Co., Chicago, Ill.) and R B Corotis (Northwestern University, Evanston, Ill.) *Solar Energy*, vol 26, no 3, 1981, p 199-212 11 refs Contract No. DE-AS06-76ET-20283

An approximate numerical method for the simulation of sequential hourly wind speed values at a site is presented. It is based on the Weibull distribution of wind speed and an exponential autocorrelation function of hourly wind speed, and appears to give realistic results although verification with historical data is required. An equivalent linearized relationship between wind speed and generated power for a regional array of wind turbines is derived. A simple method for the simulation of sequential hourly array power

can be developed. Analysis of results based on several different wind turbine characteristics in three geographical areas indicates reasonable agreement with historical records for generated power histograms, autocorrelation functions, and mean persistence K S

A81-31618 # Prediction of transverse asymmetries in MHD ducts with zero net Hall current T F Swean, Jr., D A Oliver, C D Maxwell, and S T Demetriades (STD Research Corp., Arcadia, Calif.) *AIAA Journal*, vol 19, May 1981, p 651-653 14 refs

A new class of fluid-electrical asymmetries in MHD generator channel flow are predicted. It is shown that the existence of interelectrode asymmetries is not confined to generators in which there exists a nonzero net axial current, but rather they are induced even in the case of the Faraday generators. Also demonstrated is the impact of these asymmetries upon the generator and diffuser flow. It is concluded that in MHD generators, the net axial current in the cross plane is identically zero, while at any given point in the plane, the local Hall current density is in general nonzero O C

A81-31625 Modeling and control of geothermal heating systems G M Simmons, S I Ali, and J A Batdorf (Idaho, University, Moscow, Idaho) (*Instrument Society of America, Annual Conference, Houston, Tex., Oct 20-23, 1980*) *ISA Transactions*, vol 20, no 1, 1981, p 53-58 6 refs Research supported by the Idaho Office of Energy

A single duct space heating system, with variable air volume units, has been modeled for a geothermally heated agriculture office building. The heating system response, under transient load conditions, has been determined for various control strategies. To do so, a representative cold day had been defined, and a solar input transient had been included, as were the energy inputs from interior lighting and building occupants. The control options discussed include the following: (1) the elimination of night set back, (2) the action of the zone comparator to decrease water flow in the primary heater with a subsequent increase in fresh air flow as required, (3) the use of a heating coil on a fresh air intake, which could reduce the overall geothermal demand by at least 10%, (4) the regulation of the total loop water flow rather than the use of the 3 way mixing valves, and (5) the minimization of the loop water temperature, which could be achieved by using ambient reset control for systems having large fresh air intakes. Most recommended modifications would result in overall saving of at least 20-30% K S

A81-31676 The effect of dispersal on the capacity value of wind power J Haslett (Trinity College, Dublin, Ireland) *Wind Engineering*, vol 5, no 1, 1981, p 1-5 11 refs

Recently developed methods are used to reexamine the capacity implications of wind power, both in capacity credit and reoptimized mix terms, with attention given to the dispersal effect of the wind system over geographically separated areas. The conclusions extend those of Kahn (1979) in a previous study specific to California. It is concluded that there is some benefit in the capacity credit sense, associated with dispersal, but it is not dramatic. If dispersal were to be accompanied by a decrease in the average intersite correlations in wind speed, this effect would be increased K S

A81-31677 A note on the use of the models in the estimation of wind power availability J Haslett and E Kelly (Trinity College, Dublin, Ireland) *Wind Engineering*, vol 5, no 1, 1981, p 6-11 11 refs Research supported by the National Board for Science and Technology

To calculate the expected power output from a given windmill at a given site, it is necessary to know (1) the distribution for wind speeds at the site, and (2) the characteristic power velocity curve of the given windmill. If these are not available, it is necessary to use models. A brief review is presented of the literature on the various statistical models that have been proposed, and the simplest of these, the Rayleigh distribution, is used to compare four different models of the power velocity curve. The extent to which the simpler one parameter Rayleigh model is an adequate approximation, is partly determined by the shape parameters found to fit well in practice. It is concluded that in practice the choice between alternative models of the wind speed distribution is not necessarily as important as the choice between alternative models of the shape of the power velocity in the optimal region between cut-in and rated speeds K.S.

A81-31678 Wind turbines in a turbulent wind - Energy output and the frequency of shut-downs. E A Bossanyi (Reading, University, Reading, Berks, England) *Wind Engineering*, vol 5, no 1, 1981, p 12-28 9 refs Research supported by the Science Research Council

A81-31679 Concentrator systems for wind energy, with emphasis on tip-vanes T van Holten (Delft, Technische Hogeschool, Delft, Netherlands) *Wind Engineering*, vol 5, no 1, 1981, p 29-45 10 refs

A general aerodynamic theory for wind energy concentrator systems is presented Two fundamentally different concentrator techniques are shown to exist (1) diffuser systems where the mass flux is increased by cross wind forces, and (2) ejector systems where the energy extraction per unit of primary mass flow is increased by wake mixing with the external flow, under the condition that the mixing pressure is below ambient A verification of the theory includes a tipvane augmentor system description, a comparison of the flow phenomena through a conventional turbine and one through a tipvane turbine (based on wind-tunnel tests), whereby mass flow augmentation by cross wind forces is shown, a discussion of the power required to maintain the vortex ring, and a verification of power augmentation by wake mixing effects Attention is given to some practical development problems, such as aeroelastic instabilities, turbine blade shape, and viscous interference between the turbine blade and the tipvane Costs per kWh are expected to be reduced to a level between 60% and 70% of conventional wind energy costs for 'first generation' tipvane system K S

A81-31680 The reliability of wind power systems in the UK K Newton (Cambridge, University, Cambridge, England) *Wind Engineering*, vol 5, no 1, 1981, p 46-55 21 refs Research supported by the Royal Commission for the Exhibition of 1851

A methodology has been developed to evaluate the performance of geographically distributed wind power systems Results are presented for three widely separated sites based on measured meteorological data obtained over a 17-yr period The effects of including energy storage were investigated and 150 hr storage found to be a good compromise between store capacity and system performance When used to provide space heating, the system could have reduced the 17-yr peak demand from conventional sources (smoothed by the storage and geographical separation of sites) by an amount comparable to the mean output of the wind-system, whether or not turbines at the three sites were interconnected by the National Grid In contrast, the fuel saving capability of the system was found to be comparatively insensitive either to storage period or geographical separation of sites, the system would have been capable of providing up to 90 percent of the total requirement Results are also given for individual sites to indicate the possible performance of district heating schemes or domestic systems (Author)

A81-31770 # Wave power absorption characteristics of a rocking body H Tanaka (Yokohama National University, Yokohama, Japan) and M Saito O (Tokyo, University, Tokyo, Japan) *JSM E, Bulletin*, vol 24, Feb 1981, p 370-373 6 refs

The power characteristics and efficiency of a wave power absorber consisting of a rocking body and a hydrostatic power conversion mechanism are examined The efficiency of the wave power absorber depends both on the shape of the front section of the body and on the local characteristics of the power taking off mechanism It is confirmed that the rocking body absorbs wave power with high efficiency when it is oscillated at resonant frequency and the load damping torque is controlled to be equal to half the wave exciting torque L S

A81-31826 Power limits in cylindrical gyrotrontrons using TE_{0n1} modes M E Read, K R Chu (U S Navy, Naval Research Laboratory, Washington, D C), and K J Kim (JAYCOR, Alexandria, Va) *International Journal of Infrared and Millimeter Waves*, vol 2, Mar 1981, p 159-174 13 refs Contract No DE-AC01-79ET-52053.

Scaling factors useful in the design of gyrotrontrons are presented, with stress on an electric field magnitude normalized to the frequency which can be used to determine output power for any TE mode It is shown that for CW operation, ohmic losses will limit

the maximum power obtainable Gyromonotrons are of interest as sources of high power millimeter-wave radiation for heating and preionization in fusion devices O C

A81-31888 Transport of runaway and thermal electrons due to magnetic microturbulence H E Mynick and J D Strachan (Princeton University, Princeton, N J) *Physics of Fluids*, vol 24, Apr 1981, p 695-702 15 refs Contract No DE AC02-76CH-03073

The ratio of runaway electron confinement to thermal electron energy confinement is derived for tokamaks where both processes are determined by free streaming along stochastic magnetic field lines The runaway electron confinement is enhanced at high runaway electron energies due to phase averaging over the magnetic perturbations when the runaway electron drift surfaces are displaced from the magnetic surfaces Comparison with experimental data from LT-3, Ormak, PLT, ST, and TM-3 indicates that magnetic stochasticity may explain the relative transport rates of runaways and thermal electron energy (Author)

A81-31890 Potential double layers formed by ion beam reflection in magnetized plasmas R L Stenzel (Tokyo, University, Tokyo, Japan, California, University, Los Angeles, Calif), M Ooyama, and Y Nakamura (Tokyo, University, Tokyo, Japan) *Physics of Fluids*, vol 24, Apr 1981, p 708-718 24 refs

Observations of a potential double layer formed by ion beam reflection in a collisionless magnetized plasma are reported Experiments were performed in a double plasma device with surface magnetic confinement and a positively biased source plasma anode so that an ion beam was injected into the target plasma along converging field lines and reflected at a boundary drawing electron saturation current Measurements of potential profiles in one and two dimensions, double potential and position dependences on beam and plasma parameters, the spatial and temporal evolution of the double layer and particle distribution functions show the double layers to be V-shaped, with mirror reflection and particle trapping, and axial and radial density gradients Drifting nearly Maxwellian distributions with drift velocity greater than the electron velocity are observed only on the high potential side of the double layer and satisfy the conditions for the Buneman instability Measurements imply the self-consistent formation of the observed trapped electrons, and double layer formation free from ionization effects A physical model for double layer formation is also formulated in terms of the evolution of a positive space charge layer in an electron-rich sheath A L W

A81-31974 # Review of lower hybrid results in the WEGA and PETULA experiments G Briffod (EURATOM and Commissariat a l'Energie Atomique sur la Fusion, Departement de Recherches sur la Fusion Contrôlée, Grenoble, France) In International Conference on Plasma Physics, Kiev International Conference on Plasma Theory, 4th, and International Congress on Waves and Instabilities in Plasmas, 4th, Nagoya, Japan, April 7-11, 1980, Proceedings Volume 2 Japan, Fusion Research Association of Japan, 1980, p 238-252 23 refs

It is noted that despite the increasing number of experimental results, detailed investigations of the power balance during the HF heating pulse have remained scarce and that several important questions (the identification of the heating mechanism, the origin of the observed fast ion tail, and the often observed density increase during the HF) remain to be investigated An attempt that has been made to explain these various effects on the basis of the power balance carried out in WEGA is discussed In addition, results of experiments carried out to confirm the advantages of the grill (phased waveguide array) structure up to the power density levels necessary in the future are presented The directions which present research must take to ensure applicability to large machines are also discussed C R

A81-32019 Fuel cells - Operating parameters II M A Parrish (Lambson, Ltd, Castleford, Yorks, England) *Materials in Engineering*, vol 2, Mar 1981, p 123-130 130 refs

A comprehensive review is presented of the materials and material property-related effects actively under investigation by fuel cell researchers Among the topics discussed are exchange and

limiting current densities, electron reaction rate, mass transport and reaction site area increases, electrocatalysis, electronic and geometric factors, electrode materials such as metal oxides and chelates, carbon, silver, and the platinum group metals, and electrode types such as the redox, porous, rotating or moving, gas permeable nonporous, polymeric, and dispersed or slurried O C

A81-32025 Ambitious energy project loses luster W D Metz *Science*, vol 212, May 1, 1981, p 517-519

Progress in research in laser fusion as an energy source is discussed in light of recent decisions to decrease federal funding for the project in the United States. The military origins and potential military applications of laser fusion are pointed out, and the physical basis of the process is reviewed. Problems encountered in the course of laser fusion research in the 1970s are then considered, with attention given to difficulties in achieving pellet compression which necessitated the construction of ever larger lasers, failures to achieve breakeven when expected, and complex physical interactions found during pellet irradiation. Research on alternative fusion drivers, including electron beams, light ion beams and heavy ion beams, is also indicated, and it is pointed out that those aspects of laser, along with other inertial confinement, fusion schemes which have made them most attractive as energy sources have been found unattainable. A L W

A81-32122 Direct utilization of geothermal energy in the Peoples Republic of China J W Lund *Geothermal Energy*, vol 8, Dec 1980, p 4-10 6 refs

A brief review of the direct utilization of geothermal energy in three regions of the Peoples' Republic of China is presented, stressing a development outline for the next five to ten years. The geothermal resource of the Tianjin Beijing area is mainly to be developed for space heating, whereas along the coastal area of Fujian and Guangdong, it will be developed for agriculture, and industrial and residential use. Electric power generation will be the main concern in the southwest at Tengchong. Most theoretical research will be done on geologic structure interpretation, corrosion of pump shafts and buried pipelines, and heat flow, with some interest in the study of geopressure and hot dry rock systems. Specific examples from the Tianjin area include a wool factory, a wool rug weaving shop, heating of a hotel, public bathing, and well drilling for apartment heating, fish breeding, and greenhouses. Direct use of geothermal energy in the Beijing area includes cotton dyeing, humidifying, medical purposes, and animal husbandry. Experimental geothermal electric power plants are summarized in table form. K S

A81-32125 Microinstabilities in the Wendelstein VII A stellarator observed by CO₂-laser light scattering J Meyer (British Columbia, University, Vancouver, Canada) and C Mahn (EURATOM and Max Planck-Institut für Plasmaphysik, Garching, West Germany) *Physical Review Letters*, vol 46, May 4, 1981, p 1206-1209 6 refs

Experimental results obtained with CO₂-laser-light scattering from the Wendelstein VII A stellarator plasma in Germany during the period in which a current free plasma was achieved are discussed. It is noted that homodyne detection of scattered CO₂ laser light demonstrates a close relation between microturbulence level and energy confinement in the stellarator during both ohmic and neutral-beam heating experiments. With the onset of neutral injection an abrupt order of magnitude decrease in the fluctuation parameter accompanied by a broadening of the fluctuation spectra is observed, this indicates an almost immediate improvement of containment time. C R

A81-32251 Electrodynamic processes in MHD channels with high magnetic Reynolds numbers I V Lavrent'ev and A Ia Shishko (*Magnitnaia Gidrodinamika*, July-Sept 1980, p 81-106) *Magnetohydrodynamics*, vol 16, no 3, Jan 1981, p 288-311 40 refs Translation

The current theoretical and experimental status of electrodynamic processes in MHD channel in the presence of strong induced magnetic fields is reviewed. Some aspects of the formulation of corresponding boundary value problems are examined, along with methods of solution. The local and integral characteristics of MHD channels at large magnetic Reynolds number are analyzed. New results are presented, concerning the influence of induced magnetic

fields in two channel MHD devices in the presence of effects caused by the three dimensionality of the electromagnetic field distribution V P

A81-32906 # The role and status of magnetic fusion E A Frieman *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0835* 4 p

A brief assessment is presented of the physical principles and technological development requirements of magnetic fusion devices such as the tokamak and magnetic mirror. Among the problems to be solved are: (1) MHD equilibrium and stability, (2) perpendicular ion and electron confinement, (3) parallel electron energy confinement, (4) heating by external means, (5) self heating, (6) electric potential, (7) impurity influx and (8) refueling. O C

A81-32951 PESC '80, Power Electronics Specialists Conference, Atlanta, Ga., June 16-20, 1980, Record Conference sponsored by the Institute of Electrical and Electronics Engineers New York, Institute of Electrical and Electronics Engineers, Inc., 1980 415 p Members, \$18.75, nonmembers, \$25

The conference focused on research, development, and applications in the field of power electronics. Topics discussed include power conversion techniques (dc-dc, dc-ac, ac-dc, and ac-ac), power conditioning control techniques, power semiconductor devices, power circuit components, and modeling, analysis, simulation, and measurement of power conditioning circuits and systems. V L

A81-32969 A chopper converter for electric vehicle propulsion battery charging and propulsion motor field excitation J N Park (General Electric Co., Schenectady, N.Y.) In PESC '80, Power Electronics Specialists Conference, Atlanta, Ga., June 16-20, 1980, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p 203-210 8 refs Contract No DE-AC03-76-CS 51294

A dual mode chopper power converter circuit capable of providing the separate functions of on-board propulsion battery charging and propulsion motor field excitation under microcomputer command is described. Normal charge mode delivers 24 A until a predetermined voltage is reached (when connected to an appropriate 115 V service outlet) whereupon current is tapered at constant battery voltage. Underway, the copper circuitry supplies propulsion motor field current in the range of 2 to 11 A (field weakening). The chopper power circuit employs a fast power Darlington transistor and diode packaged in modular form specifically developed for the electric vehicle application and driven by a special isolated proportional base drive circuit, providing minimum storage time and high efficiency. The power circuit uses two diodes and a field reversing relay to satisfy the topology requirements for both the battery charging and field excitation modes. The selection of modulation schemes and control strategy particular to the present application are discussed. (Author)

A81-32980 New dc/ac high power cell structure improve performances for sine generator J Jalade, J C Marpinard, and M Valentin (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France) In PESC '80, Power Electronics Specialists Conference, Atlanta, Ga., June 16-20, 1980, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p 326-331

An inverter structure is proposed which employs the techniques of pulse width modulation and storage energy dc/dc conversion. This approach makes it possible to obtain an efficiency close to that of dc/dc converters (i.e., 90 percent minimum), while providing a sine waveform with good characteristics. V L

A81-33184 A magnetic plasma compressor with an explosive magnetic energy source V V Vladimirov, I I Divnov, N I Zotov, A S Kamukov, N P Kozlov, P A Ovchinnikov, Iu S Protasov, and B D Khristoforov (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR) (*Zhurnal Tekhnicheskoi Fiziki*, vol 50, July 1980, p 1521-1524) *Soviet Physics - Technical Physics*, vol 25, July 1980, p 881, 882 Translation

The applicability of explosion driven magnetic generators as power sources for high current discharges in magnetoplasma compressors was studied experimentally. An explosion driven magnetic generator was found to be a power source of satisfactory efficiency in experiments with high current radiant discharges V P

A81-33447 Transient behavior of a class of wind turbine generators during electrical disturbances P C Krause and D T Man (Purdue University, West Lafayette, Ind) (*Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, Ga, Feb 1-6, 1981, Paper 81-WM-011-6*) *IEEE Transactions on Power Apparatus and Systems*, vol PAS-100, May 1981, p 2204-2210 6 refs Contract No EC-77-5 02-4206

Common to many present-day designs of large wind turbines is the soft shaft in the low speed part of the drive train. The untwisting of this shaft during an electrical disturbance determines the short-term transient behavior of this type of wind energy system. This feature of the mechanical system and its influence upon transient stability and thus the performance of the wind turbine generator are investigated (Author)

A81-33449 Geothermal power generation - An aggressive utility program G K Crane (Southern California Edison Co, Rosemead, Calif) (*IEEE, ASME, ASCE, Joint Power Generation Conference, Phoenix, Ariz, Sept 28-Oct 2, 1980, IEEE Paper 80-JPGC-814-4*) *IEEE Transactions on Power Apparatus and Systems*, vol PAS-100, May 1981, p 2519-2523

In the last ten years, utilities and resource production companies have made major commitments to the development of geothermal resources, located in the Imperial Valley. The program considered includes the construction of three flash steam power plants with varying objectives and designs which will assist in the assessment of the feasibility of hot water geothermal as a base load generation option. Attention is given to the geothermal potential, a 10 MW power plant project, a cooling water system, a 45 MW power plant project, an evaluation of steam condition and turbine, a Salton Sea 9 MW power plant project, resource exploration, a technology assessment, and the expected results G R

A81-33450 Magnetohydrodynamics - An engineering perspective P S Zygielbaum and A C Dolbec (Electric Power Research Institute, Palo Alto, Calif). (*IEEE, ASME, ASCE, Joint Power Generation Conference, Phoenix, Ariz, Sept 28-Oct 2, 1980, IEEE Paper 80-JPGC-816-9*) *IEEE Transactions on Power Apparatus and Systems*, vol PAS-100, May 1981, p 2529-2535 22 refs

A likely design for a first-generation, coal-fired, open cycle magnetohydrodynamic power plant is described. Key development issues and relevant current development efforts are described. The general magnitude and scope of the effort required to develop, demonstrate and commercialize the technology is compared with representative efforts expended on other power generation developments in the past. General conclusions are drawn in regard to elements essential to a successful development and commercialization effort (Author)

A81-33499 Phonon scattering at grain boundaries in heavily doped fine grained silicon-germanium alloys D M Rowe, V S Shukla, and N Savvides (University of Wales Institute of Science and Technology, Cardiff, Wales) *Nature*, vol 290, Apr 30, 1981, p 765, 766 13 refs Research supported by the British Gas Corp

Measurements of the thermal diffusivity of fine-grained hot-pressed compacts of heavily doped n-type silicon germanium alloy, currently being considered as a high-efficiency material for spacecraft thermoelectric generators, are reported. Measurements of thermal diffusivity were performed for single crystal and hot-pressed compacts of grain sizes in the ranges 10 to 25 microns, 5 to 10 microns and less than 5 microns cut from a single ingot of Si(63.5)Ge(36.5) alloy doped n type with phosphorus to about 10 to the 26th/cu m. Values of the thermal conductivity derived from the diffusivity measurements are found to decrease with a reduction in grain size, an effect attributed to phonon scattering at the grain boundaries, while the Seebeck coefficient and electrical resistivity increase slightly due to a loss of dopant in the hot pressing operation. Results thus imply that thermoelectric generators based on fine-grained semiconductor alloys would exhibit substantial improvement over those based on single crystal or large grained materials A L W

A81-33535 # Space nuclear electric power systems G L Bennett, J J Lombardo, and B J Rock (US Department of Energy, Space and Terrestrial Systems Div, Washington, DC) (*American Astronautical Society and American Institute of Aeronautics and Astronautics, Annual Meeting on Space Enhancing Technological Leadership, Boston, Mass, Oct 20-23, 1980, AAS Paper 80-220 40 p 28 refs*)

The activity of the Department of Energy in the development of space nuclear electric power systems is reviewed. DOE sponsored research and development in the area of radioisotope thermoelectric generators (RTGs) has increased the conversion efficiencies of these power systems from under 5% to 6.8% with specific powers ranging from 1.48 W/kg to 5.51 W/kg. The DOE is also sponsoring research on a dynamic isotope power system (DIPS) which uses a Rankine power conversion cycle employing an organic working fluid. A 15% system efficiency and 1000 hr endurance test have been demonstrated in a prototype system ground test unit, upon completion of technology verification, this system could be a potential candidate as a power source for spacecraft requiring up to 2 kW. In addition, for higher power levels up to 100 kW, the DOE is supporting a technology readiness program to demonstrate the key components of an advanced reactor/thermoelectric power system which is planned to meet performance objectives for a 7-10 year lifetime P T H

A81-33613 Passively switched double-pass active mirror system D C Brown, J A Abate, L Lund (Rochester University, Rochester, NY), and J Waldbillig (Eastman Kodak Co, Rochester, NY) (*Applied Optics*, vol 20, May 1, 1981, p 1588-1594 12 refs) Research supported by the Exxon Research and Engineering Co, General Electric Co, Northeast Utilities Service Co, New York State Energy Research and Development Authority, Standard Oil Co, University of Rochester, and Empire State Electric Energy Research Corp

The short-pulse (B-limited) and long-pulse (damage-limited) staging of double-passed active mirror systems is discussed. An experimental double-passed active mirror system has been constructed and operated. For a 50-J input energy and a pulse width of 700 psec, a focusable output energy of 230 J has been measured, as compared to 140 J in single-pass experiments. The results correspond to the predictions of the design and simulation code used V L

A81-33614 Dynamic pumping model for amplifier performance predictions J H Kelly, D C Brown, J A Abate, and K Teegarden (Rochester University, Rochester, NY) (*Applied Optics*, vol 20, May 1, 1981, p 1595-1605 21 refs) Research supported by the Exxon Research and Engineering Co, General Electric Co, Northeast Utilities Service Co, New York State Energy Research and Development Authority, Standard Oil Co, University of Rochester, and Empire State Electric Energy Research Corp

A dynamic pumping model has been developed for the prediction of active mirror amplifier performance and cost effective staging of Nd glass laser systems. The model is instantaneous and based on time resolved spectroscopy of 13-mm xenon filled flashlamps. The amplifier and system performance may be predicted within 10-15% by the use of small spectroscopic samples of laser glass and relatively easy measurements V L

A81-33730 Composite rotor blades for an experimental 300 kW wind turbine I J J Cools (Fokker-VFW, Schiphol, Netherlands) (*Society for the Advancement of Material and Process Engineering, Intercontinental Conference, 1st, Cannes, France, Jan 12-14, 1981*) *SAMPE Journal*, vol 17, May-June 1981, p 11-17

A description is given of the structural design and manufacture of the blades for an experimental wind turbine with a rotor diameter of 25 meters. Carbon and Aramid fiber composite materials have been applied on a large scale. Because of the experimental character of the turbine, the blade structure was designed to be manufactured with the aid of relatively simple tooling (Author)

A81-33782 Evaluation of electrode voltage drop in Faraday-type MHD generators G P Gupta and V K Rohatgi (Bhabha Atomic Research Centre, Bombay, India) (*Energy Conversion and Management*, vol 21, no 1, 1981, p 9-12 8 refs)

Extending the work of Dolson and Bibrar (1977), the finitely segmented Faraday type MHD generator (with the combustion

products seeded with an alkali metal compound) is investigated. Accounting for the finite electrode segmentation effect and the nonuniformity of gas in the channel, an expression has been derived for the gas dynamic drop for a turbulent boundary layer. Combining the electrical sheath drop with the gas dynamic drop, the electrode voltage drop has been determined and the results have been compared with two experimental runs of the MHD generator. The formulation explained satisfactorily the experimentally observed voltage drop. It was concluded that the influence of finite electrode segmentation in a Faraday-type MHD generator should be accounted for in very precise values of gas conductivity and Hall parameter in the gas core. K S

A81-33783 Research and development for shrouded wind turbines. O Igra (Negev, University, Beersheba, Israel) *Energy Conversion and Management*, vol 21, no 1, 1981, p 13-48. 30 refs. Research supported by the U S-Israel Binational Science Foundation and Ministry of Energy and Infra-Structure of Israel.

A special shroud, designed for enclosing a wind turbine in order to exploit wind power as economically as possible, is presented. Several geometries, including the short diffuser shroud and the circular wing shroud, are discussed, and it is shown that a significant power augmentation can be achieved with a fairly compact shroud. Up to an 80% improvement in the shroud power augmentation has been obtained by the use of a ring shaped flap, and proper bleeding of the shroud's external flow into its inner rear part increased its power augmentation by about 25%. The design and performance of an axial flow turbine, most suitable for the proposed shrouds, are presented, and it was shown that the turbine produces a fairly stable output for varying wind speeds while exhibiting a fairly high efficiency. The design and preliminary test results are presented of a pilot plant producing 1 hp at 5 m/s with a 3 m diameter turbine. K S

A81-33784 Interaction of fluid dynamics phenomena and generator efficiency in two phase liquid-metal gas magnetohydrodynamic power generators. G Fabris and R G Hantman (Argonne National Laboratory, Argonne, Ill.) *Energy Conversion and Management*, vol 21, no 1, 1981, p 49-60. 28 refs. Navy-supported research.

The potential loss mechanisms of a two phase (liquid-metal and gas) magnetohydrodynamic (LMMHD) electric power generator (which has the advantages of extreme design simplicity, reliability, potentially high isentropic and cycle efficiency, high power density, and the possibility of operation at moderately elevated temperatures) are discussed as they relate to various fluid dynamic phenomena, such as effects resulting from velocity slip, vorticity generation and suppression by the magnetic field wall friction, and shunt currents in liquid boundary layers. The relative importance of these effects is discussed in relation to experimental data on internal flow phenomena, and to known theory. The major source of loss was found to be slip loss, which results from a churn turbulent flow pattern. A means of creating a stable, homogeneous foam flow with almost no slip, using the surface active properties of liquid metals, is presented. Means of reducing wall shunt and frictional losses are suggested, and the effects of end losses in two-phase flows are described. K S

A81-33785 On the 'reaction in chain' in the thermo-electric conversion of energy through thermocouples - Theoretical implications of the phenomenon. M Marinescu *Energy Conversion and Management*, vol 21, no 1, 1981, p 61-64.

It is shown, experimentally, that in certain initial conditions of temperature, and for certain parameters, a 'reaction in chain' may start in a thermocouple, and produce a 'permanent regime', through which heat from a single source is converted into electrical energy. It is shown, theoretically, that the phenomenon occurs when compensation of heat losses due to thermal conduction, through Peltier and Thomson heat is realized, so that the efficiency is affected only by the Joule effect, and may attain much higher values than through conventional operation of these thermoelectric devices, conventional operation requiring two heat sources, a hot and a cold one. (Author)

A81-33934 # Experimental study of a Darrieus-type wind turbine coupled to an oil-thermal converter (Etude expérimentale

d'une éolienne de type Darrieus couplée à un convertisseur oléo-thermique). J Driviere (Ecole Nationale Supérieure d'Arts et Métiers, Paris, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov 12-14, 1980, Paper NT 80-47* 112 p. 21 refs. In French.

A Darrieus-type wind turbine has been developed for heating applications by the coupling of the turbine apparatus to an oil thermal converter. The vertical axis turbine consists of two molded fiberglass reinforced polyester blades with a NACA 0015 profile making up a rotor 2.2 m in diameter. Preliminary measurements of turbine power curves and power coefficient are in good agreement with predictions and literature values, and have been used as a basis for further testing of the entire windmill-converter apparatus. Wind-tunnel tests have been performed in a return channel of section 3 x 3 sq m in a mean flow of velocity up to 10 m/sec, and confirm predictions of power, inertia and equilibration in turbulence simulating atmospheric conditions. A means for the direction conversion of mechanical energy provided by the wind into thermal energy has been developed based on the motion of a rotating element in a viscous fluid, which is heated with a yield of nearly unity. Tests have shown theoretical determinations of the dimensions of stages for the recovery of losses due to the decrease in oil viscosity with temperature to be correct for oils of relatively low viscosity (30,000 cst at 25 C), although higher viscosity oils would allow a significant reduction in the size of the converter. A L W

A81-33939 # A two phase MHD generator - Prospects for use of solar energy (Générateur MHD à double phase - Perspective d'utilisation à l'énergie solaire). A Alemany, J C Jay, and J P Thibault (Grenoble, Institut de Mécanique, Grenoble, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov 12-14, 1980, Paper NT 80-43* 16 p. In French.

Specific aspects of a 10 kW pilot project dual phase MHD generator powered by solar heat are presented. A gas or vaporized liquid is injected into a liquid metal flow and the resulting biphasic conductor passes through a magnetized gap where electrodes at appropriate angles to the field and the flow convert the mechanical to electrical energy, the gas or liquid is then separated from the metal to be reheated by a solar heat source. Tin was chosen for its low melting temperature, 235 C, high electrical conductivity, and low oxidation reactivity with water. A quasithermal equilibrium is approached when heat lost by infusion of expanded gas into liquid metal is regained from the tin, which displays high volumetric specific caloric content. Reheated gas can be used in a low pressure topping cycle turbine after separation. Further studies on behavior of water droplets in liquid metal, high speed liquid metal flow to reduce annular effects on conductivity, and of ohmic dissipation of thermal energy are indicated. D H K

A81-33940 # Low grade heat recuperation by the organic Rankine cycle (Recupération de chaleur à bas niveau par cycle de Rankine à fluide organique). A Verneau (Société Bertin et Cie, Plaisir, Yvelines, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 17th, Grenoble, France, Nov. 12-14, 1980, Paper NT 80-45* 47 p. In French.

The use of an organic Rankine cycle engine in the conversion of low-grade industrial waste heat into mechanical energy is examined. The principles of a Rankine system using a vapor as the working fluid at operating temperatures from 100 to 500 C are presented, and the advantages of using organic vapors rather than water in the Rankine cycle are pointed out. Attention is then given to the Rankine cycle itself, the organic fluids employed, the multistage low power turbines and the evaporator, which acts as a countercurrent heat exchanger. Economic aspects of the use of Rankine cycle systems for industrial waste heat recovery are then considered, and examples are presented of the calculation of power recovered and investment costs for the examples of heat recovery from diesel exhaust and from low pressure steam. A L W

A81-33941 # The vertical-axis wind turbine - Unsteady aerodynamic forces on a Darrieus rotor (Eolienne à axe vertical - Efforts aérodynamiques instantanés sur un rotor de Darrieus). B Chezelepretre (Société Bertin et Cie, Plaisir, Yvelines, France) *Association Aéronautique et Astronautique de France, Colloque*

d'Aerodynamique Appliquée, 17th, Grenoble, France, Nov 12-14, 1980, Paper NT 80-46 42 p In French

Unsteady aerodynamic forces on a Darrieus wind turbine can give rise to fatigue cracking and vibrations in the rotor blades. The present paper presents an experimental and theoretical study of aerodynamic forces during blade rotation. Measurements of pressure differences between homologous points on either side of the rotor were obtained for a two-bladed Darrieus wind turbine with NACA 0012 profiles operating at speeds up to 600 rotations/min. Pressure fluctuation spectra and normal aerodynamic forces were then computed for various rotor tip speed/wind speed ratios. Calculations were also performed in terms of a quasi-steady multitude model of the flow traversing the upstream and downstream sections of the wind turbine treated separately. Good agreement between predicted and observed values of peak pressure and the development of aerodynamic forces on the upstream side is obtained, while less good agreement is obtained on the downstream side, due to uncertainties associated with the operation of this side in the wake of the upstream side. Results also demonstrate that the centripetal forces exceed the centrifugal forces by a factor of 2 to 3, and the presence of nonnegligible levels of harmonic vibrations. A L W

A81-34022 Results of thermal tests on the GTA-18 gas turbine unit with the RD-ZM 500 jet engine. V P Polivanov, G G Ol'khovskii, L V Povolotskii, M P Kaplan, L A Chernomordik, A O Bumarskov, I N Skvirskii, P I Korzh, and A G Tumanovskii (Khar'kovskii Turbinnyi Zavod, Kharkov, Ukrainian SSR, Vsesoiuznyi Teploekhnicheskii Institut, Moscow, Soiuzezhenergo, USSR) (*Teploenergetika*, vol 27, Aug 1980, p 23-28) *Thermal Engineering*, vol 27, Aug 1980, p 432-436 Translation

The GTA-18 gas turbine plant (15.20 MW) has been tested on liquid fuel (aviation kerosene and diesel fuel) at ambient temperatures of 20-27 and -2 C and on natural gas at +5 and -10 C. The tests were conducted under industrial conditions at a heat and power generating facility. At +15 and +5 C, power outputs of 16.8 and 18.6 MW and efficiencies of 20.3 and 21.1%, respectively, have been obtained. V L

A81-34060 Characteristics of the flow of a two-temperature plasma of inert gases in an MHD channel. A L Genkin, V L Goriachev, N N Dumenskii, and A S Remennyi (*Teplofizika Vysokikh Temperatur*, vol 18, July-Aug 1980, p 852-856) *High Temperature*, vol 18, no 4, Jan 1981, p 663-667 6 refs Translation

An analysis is presented of the flow characteristics of a two-temperature plasma of inert gases without the addition of alkali metals in an ideally sectioned MHD channel of Faraday type. The specific flow characteristics of plasmas in ionization equilibrium and nonequilibrium are examined, and the integral characteristics of the MHD channel for the flow conditions under consideration are determined. It is shown that, with the flow of a nonequilibrium recombination plasma of pure inert gases, relatively high values of isentropic efficiency and energy conversion efficiency can be obtained not only for a homogeneous plasma but also for a plasma in which ionization instability develops. B J

A81-34062 Kinetics of the desulfurization of an exhausted ionizing additive in a MHD electric power plant. Ia M Vizel', R A Ibragimov, and I L Mostinskii (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 18, July-Aug 1980, p 863-869) *High Temperature*, vol 18, no 4, Jan 1981, p 672-678 9 refs Translation

The removal of sulfur oxides from exhaust gases is an acute problem in the operation of open-cycle MHD power plants. This paper proposes a method for calculating the rate of reaction between potassium sulfate and hydrogen at temperatures of 1033-1073 K. The method is based on the assumption that the process occurs in two stages: activated adsorption and a reaction in the adsorbed phase. An experimental desulfurization unit operating on these principles is described, and results of calculations are compared with experimental data. B J

A81-34097 A diverted plasma reversed field pinch. W Manheimer (U.S. Navy, Naval Research Laboratory, Washington, D.C.) (*Physics of Fluids*, vol 24, May 1981, p 986-987 8 refs

Research supported by the U.S. Department of Energy

It is proposed that reversed-field pinches could be run with a magnetic divertor. The divertor would allow a high current density to exist right up to the plasma edge, but could substantially reduce the plasma wall interactions inherent in a state with high current density right at the plasma edge. The divertor could be set up with the vertical field coils that are common in toroidal configurations. B J

A81-34362 Turbine engine design. C B Wrong (Pratt and Whitney Aircraft of Canada, Ltd., Longueuil, Quebec, Canada) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display on Frontiers of Achievement, Long Beach, Calif., May 12-14, 1981, Paper 81-0915 28 p*

The history of the PT6 powerplant is discussed with the objective to demonstrate the value of finding a simple solution to given design problems. The PT6 was conceived as a powerplant, nominally of 500 horsepower, aimed at helicopter and executive turboprop markets. The only realistic choice of engine cycle was that of a free power turbine dictated essentially by helicopter requirements, freedom from controls complexity, and substantially easier starting characteristics. A major turning point in the quest for a configuration which blended aerodynamic and mechanical simplicity, was the adoption of the back-to-back rotor system. Attention is given to a pipe diffuser, problems of disk attachment, integral turbine vane rings, fused power turbine blades, and the jet flap. G R

A81-34705 Some problems concerning divertor systems for thermonuclear systems and torsatron reactors (O nekotorykh problemakh divortornykh sistem termoiadernykh ustanovok i reaktora tipa torsatron). V B Iufarov, G P Glazunov, V G Kotenko, G G Lesniakov, E I Skibenko, and Iu V Kholod (Akademiia Nauk Ukrainsskoi SSR, Fiziko Tekhnicheskii Institut, Kharkov, Ukrainian SSR) (*Voprosy Atomnoi Nauki i Tekhniki, Seriya Obshchaya i Iadernaia Fizika*, no 4, 1980, p 32-36 10 refs In Russian

Problems associated with divertor design and cryogenic pumping for fusion reactors are considered. The use of divertors to reduce plasma contamination is examined, and it is shown that, for large transverse dimensions and high densities of the plasma, it is possible to increase the neutral gas density to 10 to the 11th to 10 to the 12th per cu cm without significant effect on the plasma parameters. Hydrogen and helium fluxes will have pressures of 4000 and 100 mm Hg, respectively, for a fusion reactor with a power output of 10 GW. Methods for the pumping of hydrogen and helium in fusion systems are compared in terms of efficiency, the use of a combination of pumping methods is found to be necessary. Attention is given to the selection of the magnetic configuration of the divertor in such a way as to optimally solve the cryogenic pumping problem. P T H

A81-34864 Divertors with strong re-cycling in the layer near the wall. A V Nedospasov and M Z Tokar' (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) (*Nuclear Fusion*, vol 21, Apr 1981, p 465-472 13 refs Translation

A narrow divertor layer is considered under the assumption of anomalous (Bohm) coefficients of plasma transport across the magnetic field. It is established that the plasma parameters in such a divertor are affected significantly by the recycling of matter from the wall in the form of neutral atoms and by the anomalous plasma viscosity. Account is taken of the cooling effect of the secondary processes occurring on the collector plates. The system of hydrodynamic equations describing the plasma is solved analytically and numerically, and the plasma density and temperature distributions in the divertor are found. The behavior of impurities sputtered from the first wall is discussed. It is shown that at high specific thermal fluxes to the wall, which are necessary for the economic feasibility of a tokamak reactor, a narrow divertor is capable of maintaining a sufficiently low impurity concentration in the working volume and would enable the unburnt fuel and helium to be removed from the reactor. (Author)

A81-34872 Materials technology for fusion - Current status and future requirements. R E Gold (Westinghouse Electric Corp., Pittsburgh, Pa.), E E Bloom (Oak Ridge National Laboratory, Oak Ridge, Tenn.), F W Clinard, Jr (California University, Los Alamos, N. Mex.), D L Smith (Argonne National Laboratory,

Argonne, Ill.), R D Stevenson (Inesco, Inc., San Diego, Calif.), and W G Wolfer (Wisconsin, University, Madison, Wis.) *Nuclear Technology/Fusion*, vol 1, Apr 1981, p 169-237 250 refs Research supported by the U.S. Department of Energy

The general status of the materials research and development activities currently under way in support of controlled thermonuclear fusion reactors in the United States is reviewed. In the area of magnetic confinement configurations, attention is given to development programs for first wall materials, which are at various stages for possible austenitic stainless steels, high strength Fe-Ni-Cr alloys, reactive and refractory metal alloys, specially designed long range ordered and rapidly solidified alloys, and ferritic/martensitic steels, and for tritium breeding materials, electrical insulators, ceramics, and coolants. The development of materials for inertial confinement reactors is also surveyed in relation to the protection scheme employed for the first wall and the effects of pulsed neutron irradiation. Finally, the materials requirements and selection procedures for the ETF/INTOR and Starfire tokamak reactor designs are examined. Needs for the expansion of research on nonfirst wall materials and inertial confinement fusion reactor material requirements are pointed out. A L W

A81-34929 A study on the performance of a gyrotron. H. Doring (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany) and Y. Wei. *International Journal of Infrared and Millimeter Waves*, vol 2, May 1981, p 437-452 11 refs

A method is presented for calculating the large signal beam efficiency and output power of a gyrotron operating at an arbitrary harmonic of the cyclotron frequency. It is shown that by contouring the RF field distribution and using efficiency optimized parameters, it is possible to achieve efficiencies more than twice the value obtainable at constant electric and magnetic fields. It is also shown that higher output powers can be achieved at a cyclotron harmonic and higher order TEM modes with higher beam voltages. V L

A81-35035 Hall effects in magnetohydrodynamic flows. B K Shivamoggi (Australian National University, Canberra, Australia). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol 26, Mar-Apr 1981, p 341-350 7 refs USAF-supported research

The effects of Hall currents arising in tenuous plasmas in strong magnetic fields are analyzed for three examples of magnetohydrodynamic flows. For the case of the impulsive motion of an infinite flat plate in a viscous plasma in the presence of a transverse magnetic field, Hall effects are shown to lead to an additional augmentation of the flow at infinity, due to the reduction of the retarding effect of the transverse magnetic field on the primary flow. In the Ekman layer of a viscous rotating plasma bounded by an infinite horizontal porous plate in a vertical magnetic field, the Hall effect is found to increase the angle through which the velocity vector at a certain height rotates from the direction of the applied pressure gradient, thereby decreasing the thickness of the Ekman layer and the mass flux of the plasma within it. Finally, in the case of a fluctuating flow of a viscous plasma on a porous plate with a transverse magnetic field, the Hall effects are shown not to alter the time dependent response of the boundary layer flow to superimposed fluctuations, although skin friction at the plate is increased. A L W

A81-35142 Salt hydrates as absorbents in heat pump cycles. M A Stanish and D D Perlmutter (Pennsylvania, University, Philadelphia, Pa.). *Solar Energy*, vol 26, no 4, 1981, p 333-339 9 refs Contract No. EY-76 S 02-2747

A thermodynamic analysis has shown that inorganic salt hydrates are attractive candidates for absorbents in heat pump cycles. Their computed performance efficiencies compare favorably to those of previously proposed solid and liquid absorbents, under conditions typical of domestic, solar-powered, intermittent operation. It was found that hydrate cooling cycles, with coefficients of performance in the range of 0.6-0.7, can significantly outperform all others considered. In space heating applications, solid-absorbent cycles were far superior to a typical liquid-absorbent cycle in both overall efficiency and per cent of thermal energy input stored. Predicted hydrate coefficients of performance were in the range 1.4-1.6 with 75-85 per cent effective storage. (Author)

A81-35160 Design models of potential field sources for MHD generator coils (Raschetnye modeli istochnikov potentsial'nogo polia dlia obmotok MGD generatorov). V N Boronin and M R Vinokurov. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Mar-Apr 1981, p 98-105 6 refs In Russian

A81-36025 A harmonic flux induction type on board auxiliary power source system for levitated trains. T Iwahana, T Fujimoto (Japanese National Railways, Railway Technical Research Institute, Tokyo, Japan), N Maki, and H Takahashi (Hitachi, Ltd., Ibaraki, Japan). *Institute of Electrical and Electronics Engineers, Winter Meeting, Atlanta, Ga., Feb 16, 1981* IEEE Transactions on Power Apparatus and Systems, vol PAS 100, June 1981, p 2898-2906

This report describes the principle and characteristics of, and the test results obtained with, a new harmonic flux induction type on board power source system (HIPS) suitable for high speed magnetically levitated trains. The system uses a space harmonic component of the flux produced by track coils to supply power to train induction coils. Various characteristics of the induced voltage and output power of the HIPS are discussed, and it is found that an output power of 100 kW/car with the system is obtainable. The results obtained in calculations agree with those obtained in tests with a rotating experimental facility having an output power of 1 kW. (Author)

A81-36500 Application of computerized tomography techniques to tokamak diagnostics. R C Chase, F H Segun, M Gerassimenko, and R Petrasso (American Science and Engineering, Inc., Cambridge, Mass.). *Optical Engineering*, vol 20, May-June 1981, p 486-492 16 refs Contract No. DE AC02 77ET-53068

The feasibility of using the techniques of computerized tomography to investigate plasma X-ray emissivity distributions in tokamaks is discussed. Results of tomographic reconstructions of simulated data sets representing soft X-ray emission from two test patterns detected by a linear detector array are presented corresponding to systems with up to 60 views and 64 detectors per view. Distributions reconstructed using a convolve and back-project algorithm with or without expansion of the data set to include interpolated synthetic data are shown to be reasonably accurate even for viewing numbers down to seven, for which a modification of the simultaneous iterative reconstruction technique was used. The application of the technique to the reconstruction of an image from real data taken on the Alcator A tokamak with a single slit apparatus is discussed. A L W

A81-36641 Glacial melt water in Greenland - A renewable resource for the future. G R Alther (International Minerals and Chemical Corp., Detroit, Mich.), L C Ruedisili (Toledo, University, Toledo, Ohio), H Stauber (Zurich, Eidgenössische Technische Hochschule, Zurich, Switzerland), and C F Kolbrunner. *International Journal of Energy Research*, vol 5, Apr-June 1981, p 183-190 10 refs

Glacial melt water in Greenland can be used as a renewable resource for generating electricity (a yearly estimate of 60-115 GW), and it can serve as a supplementary source for drinking and irrigation, metallurgical processing, and the manufacturing of liquid hydrogen as fuel. Southern Greenland is particularly suited for this melt water hydropower project, having high precipitation and summer temperatures, large quantities of melt water, natural 'nunatak' dams, and coastal ranges with steep gradients. Transportation of the generated energy is proposed in the form of sea cables and overland transmission lines, hydrogen gas pipelines, and tankers for liquid hydrogen transport. A hypothetical glacial power station is schematically illustrated, and production costs are calculated. The glacial melt project would serve as an economical source of energy with minimal damage to the environment. J F

A81-37019 Observation of the low-frequency ion acoustic instability in the turbulently heated TRIAM 1 tokamak plasma. O Mitarai, Y Nakamura, K Nakamura, N Hiraki, K Toi, Y Kawai, S Itoh (Kyushu University, Fukuoka, Japan), and T Watanabe. *Kyushu University, Research Institute for Applied Mechanics, Reports*, vol 28, Dec 1980, p 61-72 9 refs

A81-37063 Plasma erosion switches with imploding plasma loads on a multiterawatt pulsed power generator R Stringfield, R Schneider, R D Genuario, I Roth, K Childers, C Stallings, and D Dakin (Physics International Co, San Leandro, Calif) *Journal of Applied Physics*, vol 52, Mar 1981, p 1278-1284 5 refs Research supported by the U S Defense Nuclear Agency

Plasma erosion switches have been fielded on the PITHON generator during imploding plasma experiments Theta pinch plasma guns were used to inject carbon plasmas of densities in the range of 10 to the 12th to 10 to the 14th/cu cm between the electrodes of the vacuum power feed region, upstream from an imploding plasma load Current monitors indicated that the erosion switches carried substantial current early in time, diverting it from the load Late in the pulse the erosion switches opened, transferring the current to an imploding plasma with the effect of sharpening the current rise time at the load Associated with the sharper rise time was an improvement in the quality of the plasma implosions The results of varying the density and total number of particles in the plasma of the switches are presented with regard to the effect on the current along the vacuum feed and on the behavior of vacuum flowing electrons

(Author)

A81-37093 Measuring fuel rho R for inertial fusion experiments using neutron elastic-scattering reactions S Skupsky and S Kacanjur (Rochester, University, Rochester, N Y) *Journal of Applied Physics*, vol 52, Apr 1981, p 2608-2613 12 refs Research supported by the Exxon Research and Engineering Co, General Electric Co, New York State Energy Research and Development Authority, Northeast Utilities, Standard Oil Co (Ohio), University of Rochester, and Empire State Electric Energy Research Corp

A computer simulation was used to examine the neutron elastic scattering reactions to be used as a diagnostic tool for measuring the fuel density-radius product The method has the advantage of directly measuring the density-radius product of the fuel without special target preparation for the target density-radius product of approximately less than 0.2 g/sq cm, and it requires a significantly lower neutron yield Previously anticipated uncertainties were removed by correlating the distortion of the scattered-ion distribution with an energy loss of DD protons for low density-radius products and with D-He 3 protons for large density-radius products It was concluded that up to the threshold density-radius product required for thermonuclear ignition for inertial fusion, the diagnostic presented can be considered as an alternative or a supplement to the nuclear activation technique now in use

K S

A81-37100 Measurement of vibrational populations in low-pressure hydrogen plasma by coherent anti-Stokes Raman scattering M Pealat, J P E Taran, J Taillet (ONERA, Châtillon-sous-Bagneux, Hauts de Seine, France), M Bacal, and A M Bruneau (Ecole Polytechnique, Palaiseau, Essonne, France) *Journal of Applied Physics*, vol 52, Apr 1981, p 2687-2691 17 refs

Vibrational populations in a low-pressure H2 plasma have been measured by coherent anti-Stokes Raman scattering (CARS) The plasma generator is described, and some particulars of the optical arrangement are given The CARS system is a commercial spectrometer, whose original optical system has been slightly modified for this study, by eliminating the Polarex arrangement for the YAG laser oscillator and by adding a YAG amplifier stage This has resulted in improved beam quality and enhanced peak power For an electron density of 2×10^{11} cm⁻³ to the 11th cm to the 0.001 and a total pressure of 0.13 mbar, the rotational temperature was found to be 475 K The populations of the vibrational states v equals 0, 1, and 2 have also been measured Their distribution is non Boltzmann The influence of pressure and discharge parameters is discussed

K S

A81-37103 * Fluctuations and turbulence in an electric field Bumpy Torus plasma J R Roth (Tennessee, University, Knoxville, Tenn), W M Krawczonek (NASA, Lewis Research Center, Cleveland, Ohio), E J Powers, Y C Kim, and J Y Hong (Texas, University, Austin, Tex) *Journal of Applied Physics*, vol 52, Apr 1981, p 2705-2713 17 refs Grant No Nsg 3089

Fluctuation characteristics of plasma number density and electrostatic potential below the ion plasma and ion cyclotron frequencies in an electric field Bumpy Torus plasma were investigated experimentally, using digitally implemented spectral analysis

techniques The toroidal plasma was biased to high potentials by applying positive or negative voltage to electrodes located in the midplanes of two sectors of the toroidal array The plasma was observed to be biased to 80 or 90% of the potential on the midplane electrodes, regardless of polarity The radial electric field exceeded 1 kV/cm at the plasma boundary and penetrated inward to at least one half of the plasma radius When the imposed radial electric fields reached values characteristic of the experiment, the E/B drift velocities were comparable to the particle thermal velocities The amplitude statistics of both the density and the potential fluctuations were found to be Gaussian for the most part, with near-zero skewness and a kurtosis of about 3.0 The spectral index of the density and potential fluctuations ranged from 2 to 6 The higher frequency components were found to propagate faster than the E/B drift velocity, which is the characteristic speed of the lower frequency components

K S

A81-37115 # Prediction of shock fronts in MHD generators S M Marty, J J Lowke, and H K Messerle (Sydney, University, Sydney, Australia) *Institution of Engineers (Australia), Electrical Engineering Transactions*, vol EE 16, Sept 1980, p 83-88 10 refs

Shock fronts are liable to occur in MHD generators when operated at loads varying from design conditions Theoretical predictions are made of the position of shock fronts and their influence on output power in an experimental MHD generator as a function of current loading, mass flow and area ratio The effect of friction and heat-loss terms on the predicted axial distributions of temperature, pressure and Mach number are examined Material functions of the MHD plasma obtained from oxidized ethyl alcohol are first calculated as a function of temperature and pressure

(Author)

A81-37116 # Estimating sizes and outputs from wind energy systems J van Leersum (Commonwealth Scientific and Industrial Research Organization, Div of Mechanical Engineering, Melbourne, Australia) *Institution of Engineers (Australia), Electrical Engineering Transactions*, vol EE 16, Sept 1980, p 120-127 7 refs

A simple method for evaluating the annual energy output from wind turbo generators connected into an existing electrical network is given A model for determining the relationship between load fraction supplied by wind and storage size is developed for wind energy conversion systems containing energy stores and auxiliary power supplies Some general trends predicted by this model are given, and related conclusions drawn

(Author)

A81-37174 Reconnection phenomena during the formation phase of field reversal experiments D W Hewett and C E Seyler (California, University, Los Alamos, N Mex) *Physical Review Letters*, vol 46, June 8, 1981, p 1519-1522 8 refs

The results of hybrid simulations of the formation and the evolution to equilibrium of field-reversal experiment (FRX) configurations are presented The observed rapid reconnection is explained in terms of forced reconnection driven by a Kruskal-Schwarzschild instability and the self-consistent production of toroidal magnetic field

(Author)

A81-37276 Laser fusion experiments, facilities, and diagnostics at Lawrence Livermore National Laboratory H G Ahlstrom (California, University, Livermore, Calif) *Applied Optics*, vol 20, June 1, 1981, p 1902-1925 62 refs Contract No W 7405 eng 48

An extensive and detailed introduction is given for the range of technology development, experimental facilities and analytical methods used at Lawrence Livermore Laboratory for laser fusion research Upon the completion of numerous experiments with the 20 beam, 30 TW Shiva laser system, work has begun on the Nova Nd glass laser design which is expected to produce 100 kJ and 100 TW in the next several years This technology has been developed to the point that a MJ class Nd glass facility could be operating in the 1985-87 period to prove the performance requirements of inertial confinement fusion targets Laser fusion target fabrication development has also progressed to allow both fusion target performance development and the incorporation of diagnostic measurement equipment with which to determine the spatial temporal and spectral behavior of the fusion targets

O C

A81-37344 The capacity credit of wind power - A theoretical analysis J Haslett (Trinity College, Dublin, Ireland) and M Diesendorf (Commonwealth Scientific and Industrial Research Organization, Div of Mathematics and Statistics, Canberra, Australia) *Solar Energy*, vol 26 no 5, 1981, p 391-401 14 refs Research supported by the National Energy Research Development and Demonstration Council

The development of a probabilistic model of capacity credit for wind power in an electricity grid is discussed, and two concepts are studied (1) the equivalent conventional capacity, and (2) the equivalent firm capacity. The model is developed by introducing a more realistic probability distribution of wind power output than the normal distribution, and by calculating the loss of load probability. The main findings indicate that the use of simple models of the variation of load, wind power and plant availability allows comparisons to be made between various alternative measures of capacity credit. For small penetrations of wind power into the grid, the capacity credit is approximately equal to the average wind power output, while for large penetrations the credit tends to a limit which is determined by the probability of zero wind power and the conventional plant characteristics. E B

A81-37777 Application of computerized tomography techniques to tokamak diagnostics R C Chase, F H Seguin, M Gerassimenko, and R Petrasso (American Science and Engineering, Inc., Cambridge, MA) In 1980 International Optical Computing Conference, Washington, DC, April 8-11, 1980, Proceedings Book 1 Bellingham, WA, Society of Photo Optical Instrumentation Engineers, 1980, p 265-272 16 refs Contract No DE-AC02 77ET-53068

The considered investigation is concerned with the feasibility of using arrangements of X-ray detectors in conjunction with the methods of medical X-ray tomography to reconstruct true cross sectional maps of plasma column X-ray emissivity. It is shown that the instantaneous and unconstrained reconstruction of a confined plasma cross section is possible even with a somewhat limited number of views and detectors. The techniques briefly outlined would be a natural extension of techniques developed in the field of medical computerized tomography. Cross sectional X-ray 'photo graphs' of a tokamak plasma would be immensely useful for studying all phases of the containment process. X-ray imaging systems which allow at least moderate reconstruction accuracy could in principle be installed on existing plasma confinement devices. G R

A81-37888 Experimental and theoretical studies of the effects of nonuniformities in equilibrium magnetohydrodynamic flows M Rosenbaum, J F Louis (MIT, Cambridge, MA), and S E Shamma (MIT, Cambridge, MA, West Florida University, Pensacola, FL) *Physics of Fluids*, vol 24, June 1981, p 1032-1039 12 refs Contract No DE-AC01 79FT-15518

Results of experimental studies of the effects of thermal and velocity nonuniformities on magnetohydrodynamic flows in an equilibrium plasma with a range of Hall coefficients are presented and compared with the predictions of theoretical models. Experiments were performed in an electrodeless radial flow magnetohydrodynamic generator with equally spaced cold blades introduced into the flow to create well defined two dimensional wake nonuniformities in the direction normal to the magnetic field and the flow. Theoretical predictions were derived from a detailed two-dimensional electrodynamic analysis and from a simplified engineering model based on a generalization of the layer model of Rosa (1962). Both the experimental and theoretical results confirm the strong degradation of the effective Hall coefficient of the plasma when the Hall coefficient and the conductivity of the nonuniformities are high. The experiments thus validate the analytical studies and support the use of layer models to describe the effects of boundary layers on linear magnetohydrodynamic device performance. A L W

A81-37896 Stability of multipoles to ballooning modes with large toroidal mode number, E A Adler (California, University, Los Angeles, CA) and Y C Lee (Maryland, University, College Park, MD) *Physics of Fluids*, vol 24, June 1981, p 1086-1091 12 refs Contract No DE-AM03-76SF 00010 DOE Task I

The stability of multipoles having a purely poloidal field to ballooning modes of high toroidal mode number is studied. First, a

perturbation theory based on large m is discussed and it is found that the first-order correction to the beta limit is of order $1/m$. Next, the equations for a linear quadrupole and octopole are solved and the results are compared with recent multipole experiments. (Author)

A81-37900 Turbulent heating of parametric instabilities in unmagnetized plasmas S P Kuo and B R Cheo (New York, Polytechnic Institute, Farmingdale, NY) *Physics of Fluids*, vol 24, June 1981, p 1104-1109 17 refs Grant No AF-AFOSR 79-0009

Consideration of the effect of a uniform pump field on the particle orbits in a Vlasov plasma leads to a modified diffusion coefficient. When the particles oscillate in the pump field, the turbulent wave phase velocity seen by the particles is Doppler shifted by multiples of ω_0/k (ω_0 is the pump frequency). Hence, strong interactions between the particles and various components of the turbulent field will take place. It is shown that when the pump field is sufficiently strong, bulk heating can dominate over tail heating and excitation of electrons to energy levels higher than the normal suprathermal values is possible. This field strength is within the range of laser fusion. (Author)

A81-38092 # Cross sectional current distribution in coal fired diagonal conducting wall MHD generator with slag coated walls A R Kumaran, B L Liu, and Y C L Wu (Tennessee, University, Tullahoma, TN) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1228* 10 p 17 refs Contract No DE-AC02 79ET-10815

A81-38093 # Coupled three-dimensional flow and electrical calculations for Faraday MHD generators S P Vanka and R K Ahluwalia (Argonne National Laboratory, Argonne, IL) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1230* 11 p 5 refs Contract No W-31-109 eng 38

A three dimensional model incorporating fully the interaction between the flow and electrical fields in MHD channels is presented. The model consists of Navier-Stokes equations in parabolic form, Maxwell and Ohm's law equations as they apply to the MHD situation, and a two equation turbulence model. The model predictions are first compared against the supersonic flow experimental data from the AEDC facility, these data reflect weak MHD interaction in that the flow field is little affected by the electrical power extraction. The model is then applied to high interaction subsonic flow in the AEDC channel to show the emergence of velocity overshoots, secondary flow, and the asymmetries in flow and electrical fields. (Author)

A81-38094 # MHD electrical boundary layer theory and applications to the performance of channels with partial wraparound electrodes S A Zwick, E D Doss, Y C Pan (Argonne National Laboratory, Argonne, IL), and S E Shamma (Argonne National Laboratory, Argonne, IL, West Florida University, Pensacola, FL) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1232* 14 p 10 refs Contract No W-31-109-eng-38

Analytical methods are developed for calculating the potential and currents near boundary singularities caused by electrode edges or abrupt drops in conductivity or in the induction field. A three-dimensional control volume (finite difference) model for solving the MHD electrical problems in oblique coordinates has been developed, which accounts for the near wall singular behavior accurately and can be used with relatively sparse grids. Analyses based on the model indicate that, for practical generator design where the electrode pitch is in the order of 1 to 5 cm and the wall temperature less than 2100 K, the performance of diagonal conducting wall (DCW) channels is always superior to that of channels with insulating sidewalls, although the performance of insulating sidewall channel is better at higher wall temperatures. Sidewall electrode extensions up to a wraparound of about 20% of the channel height are shown to cause an increase in power output. The output of diagonally connected channels remains approximately the same for more than 20% wraparound, whereas the power output of Faraday channels drops off with further extensions of the sidewall conductors. (Author)

A81-38112 # MHD pseudo-shock as a qualitative model in the investigation of the influence of wall roughness on the performance of supersonic generators P-C Lu and K-H Wang (Nebraska, University, Lincoln, NE) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1276* 11 p 11 refs Grant No AF-AFOSR-79-0083

A preliminary study, based on an extension of Crocco's pseudo shock model, has been carried out to explain and predict qualitatively the rather gradual pressure rise in a supersonic MHD generator, to account for the influence of wall roughness on the core flow. A system of nonlinear ordinary differential equations is formulated for the wall layer and the core, with proper electromagnetic conditions enforced at the interface. Numerical experiments are also presented, which demonstrate indeed the qualitative link between the theory of MHD pseudo-shock and the observed pressure ramp caused by rough walls (Author)

A81-38271 # Rotational interference for Darrieus rotors P Freymuth (Colorado, University, Boulder, CO) *ASME, Transactions, Journal of Solar Energy Engineering*, vol 103, May 1981, p 173, 174 6 refs

The influence of the rotational interference factor on the performance of the Darrieus rotor for rotating vertical blades is investigated in an effort to improve proposed stream tube models. The interference factor due to blade forces in the downwind direction and the rotational interference factor are determined from the average thrust and torque on the blades, using the strip theory (Wilson, 1976). The average power from the rotor is calculated, and results show that if rotational interference is taken into account, performance curves can be brought down J F

A81-38734 A 3D code for MHD equilibrium and stability R Chodura and A Schlüter (Max-Planck-Institut für Plasmaphysik, EURATOM and Garching, West Germany) *Journal of Computational Physics*, vol 41, May 1981, p 68-88 17 refs

The calculation of general three-dimensional magnetohydrostatic equilibria and the assessment of their stability is essential for designing confinement devices, such as stellarators or tokamaks. The solution of this problem can be approached analytically and numerically. A description is presented of a numerical approach. Starting from an arbitrary distribution of plasma pressure and magnetic field, this distribution is adjusted under magnetic flux, mass, and entropy conservation in such a way that the plasma energy is decreased monotonically. A state of minimum energy is thus approached which represents a MHD equilibrium. To be sure that this equilibrium is a state of minimum energy with respect to all degrees of freedom, the system is displaced stochastically from this equilibrium. It will then relax toward the old or a new equilibrium which is definitely stable G R

A81-38920 # A proposal of freezing toroidal magnetic field with the sections of superconducting hollowed cylinder in tokamak apparatus Y-H Zhang (China University of Science and Technology, Hefei, Communist China) and X-W Cao (Academia Sinica, Institute of Plasma Physics, Communist China) *Acta Physica Sinica*, vol 30, Mar 1981, p 325-332 In Chinese, with abstract in English

It is suggested that if n sections of a longitudinally cut superconducting hollow cylinder are placed in n longitudinal field coils of a system, the electric power of the longitudinal field coils can be reduced to $2/n$ by sectional freezing of the toroidal field. An equation describing the freezing field of the superconducting material is examined, and attention is given to problems of plasma stabilization and equilibration in the toroidal field B J

A81-38922 # Equilibrium theory and adiabatic compression theory of tokamaks with an elliptic cross section with some triangular deformation M-L Shao and T-C Ma (Southwestern Institute of Physics, Communist China) *Acta Physica Sinica*, vol 30, Apr 1981, p 487-496 5 refs In Chinese, with abstract in English

MHD equilibria of tokamaks with a droplet-shaped cross section (an elliptic cross section with some triangular deformation) are considered. All equilibrium solutions and the current distribution in external coils required by producing the appropriate configuration are presented. The problem of heating the plasma with such a

configuration by adiabatic compression is discussed, the variation of all the equilibrium configurations with time during the compression is given. Calculations of the equilibrium configurations and the variations in configuration and in pressure during the adiabatic compression have been carried out for several given current density profiles. Some numerical computations are presented (Author)

A81-39007 # Polarization and sidewall effects in a coal fired MHD channel - Three-dimensional calculation M Ishikawa, M H Scott, and Y C L Wu (Tennessee, University, Tullahoma, TN) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1229* 11 p 24 refs Contract No DE-AC02 79ET 10815

The effects of slag polarization of electrodes and the sidewall configuration on generator performance are studied experimentally and analytically. An analysis of the voltage-current characteristics between two generator frames measured during the operation of the TP40-07 experiment is given, along with an examination of non-uniformities of interframe voltage. Experimental data show that the polarization effect reduces about 3% of the overall electrical performance of the 60 deg diagonal conducting channel used in the study. Analytically, the effect of polarization on the local current and potential distributions is examined by solving the three-dimensional electrical potential using a finite element method. A moderate increase in conductivity in the vicinity of the cathode-side frame is found to give a calculated leakage resistance which approximates the value derived experimentally. The polarization effect results in a large change in the potential and current distributions near the frame but has a small effect on the overall electrical performance. Alternate sidewall/electrode configurations are treated analytically C R

A81-39008 # Three-dimensional effects in large-scale MHD generators C D Maxwell, T F Sween, Jr, A A Vetter, R D Crouse, D A Oliver, C D Bangerter, and S T Demetriades (STD Research Corp., Arcadia, CA) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1231* 21 p 19 refs

The three-dimensional responses of magnetohydrodynamic channel flows to (1) changes in wall temperature, (2) the presence of net axial currents, and (3) the use of unconventional electrode and wall configurations are examined computationally for large scale, linear, combustion-driven MHD generators of current interest. In the moderate interaction regime studied, high wall temperatures are shown to inhibit the development of the secondary flow-driven magneto-aerothermal instability. The control of the secondary flow pattern by manipulation of the net axial flow of current is discussed. Alternate electrode configurations for improving overall performance and suppressing the magneto-aerothermal instability are considered. The above design trade-offs will be increasingly important as interaction levels exceed those of the contemporary MHD experiments studied (Author)

A81-39143 # Development of a CVD silicon carbide-graphite-tungsten heat pipe structure P Reagan, G Miskolczy, and F Huffman (Thermo Electron Corp., Waltham, MA) *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1160* 7 p Contract No DE AC02-76ET-11292

The operational capabilities of a trilayer structure of chemically vapor-deposited (CVD) tungsten and silicon carbide over graphite have been demonstrated by tests on a one-inch diameter hemispherical hot shell thermionic converter emitter. The tests consisted of operation in a natural gas fired furnace for over 5000 hours at 1630 K and another 5900 hours at 1730 K. Additional tests demonstrated structural integrity under thermal shock and thermal cycling. A detailed description is given of the construction techniques used to fabricate such heat pipe devices, including the beam welding to tungsten end caps and the deposition of silicon carbide on the burnoff tube O C

A81-39144 * # High power densities from high temperature material interactions J F Morris (NASA, Lewis Research Center, Cleveland, OH) *American Institute of Aeronautics and Astronautics,*

Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1161 15 p 84 refs Contract No EC-77 A-31-1062

Thermionic energy conversion (TEC) and metallic-fluid heat pipes (MFHPs), offering unique advantages in terrestrial and space energy processing by virtue of operating on working fluid vaporization/condensation cycles that accept great thermal power densities at high temperatures, share complex materials problems. Simplified equations are presented that verify and solve such problems, suggesting the possibility of cost effective applications in the near term for TEC and MFHP devices. Among the problems discussed are the limitation of alkali-metal corrosion, protection against hot external gases, external and internal vaporization, interfacial reactions and diffusion, expansion coefficient matching, and creep deformation. O C

A81-39174 Fabrication and properties of a porous lithium aluminate electrolyte retainer for molten carbonate fuel cells. R N Singh, J T Dusek, and J W Sim (Argonne National Laboratory, Argonne, IL) (*American Ceramic Society, Fall Meeting, New Orleans, LA, Oct 15, 1979, Paper 32-BN-79F*) *American Ceramic Society Bulletin*, vol 60, June 1981, p 629-635 9 refs. Research supported by the U S Department of Energy.

A ceramic processing method is presented for the fabrication of the electrolyte tile containing the molten carbonate electrolyte necessary for ionic transport in a molten carbonate fuel cell. The method involves the sintering of LiAlO_2 powder into a porous structure which is subsequently impregnated in air or in vacuum with the molten mixed alkali carbonate mixture. The porosity, surface area and mean pore size and density of the sintered LiAlO_2 structures depend on starting powder characteristics and cold-pressing and sintering conditions, and the electrolyte-impregnated structures exhibit electrolyte impregnation better than 84% for all samples, as well as strength greater than the as-sintered structure. Preliminary fuel cell tests of three structures at 925 K demonstrate advantages of the sintered electrolyte tiles over conventional tiles in the areas of anode and cathode wet-seal efficiencies, cathode-to-anode cross-leakage, and stability to thermal cycling between 923 and 300 K. A L W

A81-39216 # Current status and future prospects of gas-turbine development in the USSR (O sostoyanii i perspektivakh razvitiya gazoturbostroeniya v SSSR). A M Lul'ka (Akademiya Nauk SSSR, Komissiya po Gazovym Turbinam, Moscow, USSR) *Pro-myshlennaya Teplotekhnika*, vol 3, May-June 1981, p 3-8. In Russian.

It is noted that gas turbine engines are widely used in the USSR in the gas industry as main drives for superchargers in main stations. In addition, gas turbine engines are widely used in the chemical industry as well as in the iron and steel industries, a series of standard units with output up to 100 MW operate in electric power engineering under base and peak load. Gas turbine engines are also used in shipbuilding and civil aviation. P T H

A81-39254 # Wall leakage effect on nonuniformities in diagonal MHD channels. S Kuo, E Levi, and B Cheo (New York, Polytechnic Institute, Farmingdale, NY) *Journal of Energy*, vol 5, May-June 1981, p 158-163. Contract No ET-78 C 01 3084.

The effect of wall leakage, symmetric as well as asymmetric, is examined in the linear and nonlinear regimes. It is found that the range of wavelength in the nonuniformities is reduced and in the asymmetric case splits into two separate passbands, depending on the wavelength, forward waves can propagate both upstream and downstream, and backward waves only upstream, the growth rate is minimal when the leakage at the cathode wall is four times that of the anode wall, and in all cases, a resistance introduced in the diagonal bars reduces the growth rate by a constant. (Author)

A81-39255 # Aerodynamic performance of vertical and horizontal axis wind turbines. R C Maydew and P C Klimas (Sandia Laboratories, Albuquerque, NM) *Journal of Energy*, vol 5, May-June 1981, p 189, 190. 13 refs. Research supported by the U S Department of Energy.

The aerodynamic performance of vertical and horizontal axis wind turbines is investigated, and comparison of data of the 17-m Darrieus VAWT with the 60.7-m Mod-1 HAWT and 37.8 m Mod 0A

HAWT is discussed. It is concluded that the maximum average measured power coefficients of the VAWT are about 0% 15% higher than those of the HAWTs. It is suggested that vertical wind shear may have lowered the Mod-1 HAWT aerodynamic performance, but, the magnitude of this effect could not be evaluated. It is included that generalizations which refer to the Darrieus VAWT as aerodynamically less efficient than the HAWT should be used carefully. E B

A81-39302 Optimization of the parameters of miniature thermoelectric generators. V I Granovskii, N V Kolomoets, V G Kopaev, and T N Kuvyrkina (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Teka, Moscow, USSR) (*Geliotekhnika*, vol 16, no 5, 1980, p 12-18) *Applied Solar Energy*, vol 16, no 5, 1980, p 10-16. Translation.

Methods for optimizing the parameters of miniature thermoelectric generators (MTEG) are reviewed for the case when the power developed by the generator is a few mW, the voltage is a few V and the operating temperature differential is a few tens of degrees. Low-temperature BiTe solid solutions or high temperature materials in the form of Si-Ge alloys are used as semiconductor materials. It is found that the dependence of the volume (area) occupied by the MTEG thermoelectric battery on alloying impurity concentration has the form of a parabola with a shallow minimum. By selecting the composition of the semiconductor materials for the battery legs such that high values of the initial load coefficient are produced, generator service life is increased without a significant increase in the volume (area) of the thermoelectric battery. S C S

A81-39692 # The possibilities of an explosive MHD generator as an energy source for a plasma focus (Vozmozhnosti vzryvnogo MGD-generatora kak istochnika energii dlia plazmennogo fokusa). Iu A Burenin and G A Shvetsov *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, May-June 1981, p 81-86. 9 refs. In Russian.

A81-39992 Fuel cell efficiency in a combined electrochemical-thermochemical process. E N Balko (General Electric Co., Wilmington, MA) and W Avery (Johns Hopkins University, Laurel, MD) *International Journal of Hydrogen Energy*, vol 6, no 3, 1981, p 255-266. 8 refs.

The thermodynamics of an H_2/Cl_2 fuel cell combined with a thermochemical hydrogen chloride oxidation stage are considered. Such a cycle is superior to the phosphoric acid H_2/O_2 systems but does not better the efficiency demonstrated in more advanced H_2/O_2 fuel cell systems. (Author)

A81-40582 Wingblades of glass fibre reinforced polyester for a 630 kW windturbine design, fabrication and materials testing. B S Johansen, H Lilholt, and A Lystrup (Forsogsanlaeg, Roskilde, Denmark) In *Advances in composite materials, Proceedings of the Third International Conference on Composite Materials, Paris, France, August 26-29, 1980. Volume 2* (A81-40501 18 24) Oxford, Pergamon Press, 1980, p 1355-1367.

Wingblades for a 630 kW windturbine are described. The conceptual design of the 20 m long wingblades comprises a load bearing spar with aerodynamically shaped shells. The 12 m outer spar is made of highly directional glass fibres in a polyester matrix. The spar is fabricated by a special tape winding technique, which gives a high volume fraction of glass fibres oriented nearly parallel to the spar axis. Materials testing of the spar material and component testing of (sections of) the wingblade verify the properties of the glass polyester laminate and the design of the wingblade. (Author)

N81-22025# Sandia Labs, Albuquerque N Mex Aerothermodynamics Div
COMPARISON OF FIELD AND WIND TUNNEL DARRIEUS WIND TURBINE DATA

Robert E Sheldahl Jan 1981 18 p refs
(Contract DE-AC04-78DP-00789)

(SAND-80-2469) Avail NTIS HC A02/MF A01

A 2-m-dia Darrieus Vertical Axis Wind Turbine with NACA-

05 ENERGY CONVERSION

0012 blades was extensively tested in the Vought Corporation Low Speed Wind Tunnel. The accuracy of the wind tunnel test data was verified and thus the credibility of that data base was further established. DOE

N81-22280* National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville Ala
ELECTRICAL POWER GENERATING SYSTEM Patent Application

Frank J. Nola, inventor (to NASA) Filed 16 Mar 1981 10 p (NASA-Case-MFS-25302-1 US-Patent-App-SN-253021) Avail NTIS HC A02/MF A01 CSCL 09C

An alternating current power generation system adopted to inject power in an already powered power line is discussed. The power generating system solves to adjustably couple an induction motor as a generator to an ac power line wherein the motor and power line are connected through a triac. The triac is regulated to normally turn on at a relatively late point in each half cycle of its operation whereby at less than operating speed and thus when the induction motor functions as a motor rather than as a generator, power consumption from the line is substantially reduced. The principal application will be for windmill powered generation. NASA

N81-22298 Florida Power Corp St Petersburg
ELECTRIC UTILITY SYSTEM PLANNING STUDIES FOR OTEC POWER INTEGRATION Final Report

30 Nov 1980 281 p refs
(Contract DE-AC02-79ET-29187)

(DOE/ET-29187/T8) Avail NTIS HC A13/MF A01

The integration of OTEC into the Florida Power Corporation (FTC) system was evaluated. Existing system planning procedures, assumptions, and corporate financial criteria for planning generating capacity were used without modification. A baseline configuration for an OTEC plant was developed for review with standard planning procedures. The OTEC plant characteristics and costs were incorporated in considerable detail. It was found that with the initial set of conditions, OTEC would not be economically viable. Using the same system planning procedures, a number of adjustments were made to the key study assumptions. It was found that two considerations dominate the analysis: the assumed rate of fuel cost escalation and the projected capital cost of the OTEC plant. After corporate financial analysis, it was found that even if the cost competitive criterion were to be reached, the plan including OTEC could not be financed by FPC. DOE

N81-22313* Martini Engineering Richland Wash
A COMPUTER SIMULATION OF THE TRANSIENT RESPONSE OF A 4 CYLINDER STIRLING ENGINE WITH BURNER AND AIR PREHEATER IN A VEHICLE Final Report

W R Martini Mar 1981 182 p refs
(Contracts DEN3-226 DE-A101-77CS-51040)

(NASA-CR-165262 DOE/NASA/0226-1) Avail NTIS HC A09/MF A01 CSCL 10B

A series of computer programs are presented with full documentation which simulate the transient behavior of a modern 4 cylinder Siemens arrangement Stirling engine with burner and air preheater. Cold start, cranking, idling, acceleration through 3 gear changes and steady speed operation are simulated. Sample results and complete operating instructions are given. A full source code listing of all programs are included. Author

N81-22367 Argonne National Lab Ill Energy and Environmental Systems Div

PORST, A COMPUTER CODE TO ANALYZE THE PERFORMANCE OF RETROFITTED STEAM TURBINES

C Lee and I T Hwang Sep 1980 34 p refs
(Contract W-31-109-eng-38)

(ANL/CNSV/TM-52) Avail NTIS HC A03/MF A01

The computer code PORST was developed to analyze the performance of a retrofitted steam turbine that is converted from a single generating unit to a cogenerating unit for purposes of district heating. Two retrofit schemes are considered: one converts a condensing turbine to a backpressure unit; the other allows the crossover extraction of steam between turbine cylinders. The code can analyze the performance of a turbine operating at

(1) valve-wide-open condition before retrofit (2) partial load before retrofit (3) valve-wide-open after retrofit, and (4) partial load after retrofit. DOE

N81-22372 SIGRI Electrogradhit GmbH Meitingen (West Germany)

DEVELOPMENT OF HEAVY-DUTY SiC COMPONENTS SPECIALLY FOR VEHICLE GAS TURBINES Final Report

Horst Boeder and Wolfgang Heider Bonn Bundesministerium fuer Forschung und Technologie Dec 1979 61 p In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-79-155 ISSN-0340-7608) Avail NTIS HC A04/MF A01

Given working temperatures in excess of 1000 C, corrosion and oxidation resistance as well as thermoshock resistance requirements are discussed. The improvement of material quality in particular heat conductance and of manufacturing technology are described. Prototypes of turbine rotors and rotor blades, combustion chambers, and flame tubes were produced and tested. Promising test results under simulated application conditions are reported. Author (ESA)

N81-22373 Rosenthal-Stemag Technische Keramik A.G. Selb (West Germany)

DEVELOPMENT OF HEAT RESISTANT NONCORROSIBLE SILICON CARBIDE COMPONENTS FOR GAS TURBINE APPLICATIONS Final Report

Stefan R. Schindler and Axel Krauth Bonn Bundesministerium fuer Forschung und Technologie Dec 1979 83 p In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-79-171 ISSN-0340-7608) Avail NTIS HC A05/MF A01

Ceramic materials for automobile gas turbine engines were developed. Concurrently suitable forming techniques for the production of nonrotating gas turbine engine parts, using these materials, were sought. Prototypes of combustion chambers, stators and heat exchangers were manufactured and tested. Mechanical characteristics and thermal characteristics for these components are reported. Satisfactory test results under simulated application conditions are shown. Author (ESA)

N81-22472* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

COMPARISON OF UPWIND AND DOWNWIND ROTOR OPERATIONS OF THE DOE/NASA 100-kW MOD-O WIND TURBINE

John C. Glasgow, Dean R. Miller, and Robert D. Corrigan 1981 12 p refs Presented at the 2nd DOE/NASA Wind Turbine Dyn Workshop, Cleveland, 24-26 Feb 1981

(NASA-TM-81744 E-798 DOE/NASA1028-31) Avail NTIS HC A02/MF A01 CSCL 10B

Three aspects of the test results are compared: rotor blade bending loads, rotor teeter response, and nacelle yaw moments. As a result of the tests, it is shown that while mean flatwise bending moments were unaffected by the placement of the rotor, cyclic flatwise bending tended to increase with wind speed for the downwind rotor while remaining somewhat uniform with wind speed for the upwind rotor, reflecting the effects of increased flow disturbance for a downwind rotor. Rotor teeter response was not significantly affected by the rotor location relative to the tower but appears to reflect reduced teeter stability near rated wind speed for both configurations. Teeter stability appears to return above wind speed, however. Nacelle yaw moments are higher for the upwind rotor but do not indicate significant design problems for either configuration. T M

N81-22473* Institute of Gas Technology Chicago, Ill Engineering Research Div

STABILIZING PLATINUM IN PHOSPHORIC ACID FUEL CELLS Quarterly Report, Dec 1980 - Mar 1981

Robert J. Remick Apr 1981 25 p refs
(Contracts DEN3-208 DE-A101-80ET-17088)

(NASA-CR-165311, DOE/NASA/0208-1, Rept-61051, QR-1) Avail NTIS HC A02/MF A01 CSCL 10A

The cathode of the phosphoric acid fuel cell uses a high surface area platinum catalyst supported on a carbon substrate. During operation, the small platinum crystallites sinter, causing loss in cell performance. A support was developed that stabilizes

platinum in the high surface area condition by retarding or preventing the sintering process. The approach is to form etch pits in the carbon by oxidizing the carbon in the presence of a metal oxide catalyst remove the metal oxide by an acid wash, and then deposit platinum in these pits. Results confirm the formation of etch pits in each of the three supports chosen for investigation: Vulcan XC-72R, Vulcan XC-72 that was graphitized at 2500 C, and Shawinigan Acetylene Black. T M

N81-22475# Energy Research Corp. Danbury, Conn.
TECHNOLOGY DEVELOPMENT FOR PHOSPHORIC ACID FUEL CELL POWERPLANT (PHASE 2) Quarterly Report
Larry Christner Jun 1980 49 p refs
(Contract DEN3-67 DE-AI03-79ET-11272)
(NASA-CR-165318 DOE/NASA/0067-79-6, QR-7) Avail NTIS HC A03/MF A01 CSCL 10A

Progress is reported in the development of material cell components, and reformers for on site integrated energy systems. Internal resistance and contact resistance were improved. Dissolved gases (O₂, N₂, and CO₂) were found to have no effect on the electrochemical corrosion of phenolic composites. Stack performance was increased by 100 mV over the average 1979 level. A R H

N81-22476# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
PERFORMANCE CALCULATIONS FOR 200-1000 MWe MHD/STEAM POWER PLANTS
Peter J Staiger 1981 11 p refs. Presented at the Nineteenth Symp on the Eng Aspects of Magnetohydrodyn, Tullahoma, Tenn 15-17 Jun 1981
(NASA-TM-81775, DOE/NASA/10769-16, E-836) Avail NTIS HC A02/MF A01 CSCL 10B

The effects of MHD generator length, level of oxygen enrichment, and oxygen production power on the performance of MHD/steam power plants ranging from 200 to 1000 MW in electrical output are investigated. The plants considered use oxygen enriched combustion air preheated to 1100 F. Both plants in which the MHD generator is cooled with low temperature and pressure boiler feedwater and plants in which the generator is cooled with high temperature and pressure boiler feedwater are considered. For plants using low temperature boiler feedwater for generator cooling the maximum thermodynamic efficiency is obtained with shorter generators and a lower level of oxygen enrichment compared to plants using high temperature boiler feedwater for generator cooling. The generator length at which the maximum plant efficiency occurs increases with power plant size for plants with a generator cooled by low temperature feedwater. Also shown is the relationship of the magnet stored energy requirement of the generator length and the power plant performance. Possible cost/performance tradeoffs between magnet cost and plant performance are indicated. Author

N81-22489# Argonne National Lab III Chemical Engineering Div
ADVANCED FUEL CELL DEVELOPMENT Progress Report, Apr - Jun, 1980
R D Pierce, R M Arons, J T Dusek, A V Fraioli, G H Kucera, R B Poeppel, J W Sim, and J L Smith Nov 1980 27 p refs
(Contract W-31-109-eng-38)
(ANL-80-98) Avail NTIS HC A03/MF A01

Advanced fuel cell research and development activities are described. Efforts were directed toward understanding and improving components of molten carbonate fuel cells and included operation of a 10 cm square cell. Studies continued on the development of electrolyte structures (LiAlO₂ and Li₂CO₃-K₂CO₃). Preparation of sintered LiAlO₂ as electrolyte support is described. Tape casting is presently under investigation as a method for producing green bodies to be sintered; this technique may be an improvement over cold pressing. The transition temperature for the (ALPHA) to (BETA) LiAlO₂ allotropic transformation is determined using differential thermal analysis. Electroless nickel plating is investigated as a means of providing corrosion protection to structural hardware. DOE

N81-22509# California Univ., Livermore Lawrence Livermore Lab
STUDIES OF BRINE CHEMISTRY AND SCALING AT THE

SALTON SEA GEOTHERMAL FIELD Final Report, 1977 1979

J E Harrar Jan 1981 45 p refs
(Contract W-7405-eng-48)
(UCID-18917) Avail NTIS HC A03/MF A01

Features of studies related to brine chemistry and scaling are reported. The results of investigations of brine chemistry, the effects of brine acidification and organic additives on the rate of scale formation and scale composition, and the use of other additives for scale control are summarized. High salinity, high silica geothermal brines were studied and it was shown that the silica and sulfide scales formed from these brines could be eliminated by lowering the pH of brine. The following steps were completed: testing of technical chemical solutions to the scaling problem; finding low cost metallic materials that will resist the brine; proving a method for the treatment of spent brine for injection; perfection of chemical measurement techniques. Most environmental issues are addressed and first increments of electrical power are generated. E A K

N81-22512# Rockwell International Corp., Golden, Colo. Energy Systems Group
SWECS COST OF ENERGY BASED ON LIFE CYCLE COSTING

W R Briggs May 1980 55 p refs
(Contract DE-AC04-76DP-03533)
(RFP-3120/3533/80-13) Avail NTIS HC A04/MF A01

The Small Wind Energy Conversion Systems (SWECS) sizes considered were 1-2 kW, 8 kW, and 40 kW units. Systems costs were based on an assumed sales of 1000 units of each SWECS per year. The results of the LCC analysis show SWECS cost of energy to be competitive with grid electricity costs of energy over the projected lifetimes of the SWECS depending on competing energy cost at the SWECS location, average wind velocity and efficiency of utilization of SWECS-generated energy. DOE

N81-22513# Rockwell International Corp., Golden, Colo.
PINSON C2E WIND TURBINE GENERATOR FAILURE ANALYSIS AND CORRECTIVE DESIGN MODIFICATION
M J Carr, V K Grotzky, and J Sexton Mar 1980 26 p refs
(Contract DE-AF04-76DP-03533)
(RFP-3148/3533/80-16) Avail NTIS HC A03/MF A01

On December 4, 1978 wind speeds at the Rocky Flats Small Wind Systems Test Center reached 42 m/s. Two failures were observed on the Pinson C2E wind turbine generator during a routine inspection of all wind machines following this windstorm. One failure was fatigue cracks which formed on plates welded to the rotor shaft. The second failure was a number of cracks in the skin of all three blades. Although the possibility exists that the high winds of that data contributed to these failures, no conclusive data exist substantiating this theory. In fact, the C2E's feathering mechanism functioned normally during the windstorm, thereby controlling rotor overspeed, a potential cause of damage. DOE

N81-22522# Science Applications, Inc. McLean, Va.
HOT GAS CLEANUP FOR MOLTEN CARBONATE FUEL CELLS: A ZINC REACTOR MODEL Final Report
George Steinfeld 16 Sep 1980 91 p refs
(Contracts DE-AT21-78MC-08333, DE-AM21-78MC-08333)
(DOE/METC-08333/105) Avail NTIS HC A05/MF A01

Of the two near term options available for desulfurization of gasifier effluent, namely low temperature cleanup utilizing absorber/stripper technology, and hot gas cleanup utilizing metal oxides, there is a clear advantage to using hot gas cleanup. Since the MCFC will operate at 1200 F, and the gasifier effluent could be between 1200 to 1900 F, a hot gas cleanup system will require little or no change in process gas temperature, thereby contributing to a high overall system efficiency. Simulated operating characteristics to aid in system design and system simulations of gasifier/MCFC systems are described. The modeling of the ZnO reactor is presented. DOE

N81-22527# ARO, Inc., Arnold Air Force Station, Tenn.
REPORT ON THE MHD PERFORMANCE DEMONSTRATION EXPERIMENT Progress Report, 1 Oct 1979 - 30 Sep 1980
R F Starr, L S Christensen, G L Whitehead, G W Garrison, B L Seiber, and R L Lowry AEDC Oct 1980 156 p refs

05 ENERGY CONVERSION

(Contract DE-AI01-78ET-11417 ET-78-I-01-2895)
(FE-2895-10) Avail NTIS HC A08/MF A01

Initial experimental results were obtained with the channel configured in the Faraday mode. The resistive loading was selected to give low supersonic velocities over the entire channel length. Tests were conducted at magnetic fields up to 4.1 Tesla (T) (70 percent of design). Up to 23.5 MW of power were produced to date (50 percent of design) for an enthalpy extraction of approximately 9 percent. Several electrical and hardware deterioration problems developed during operation. High voltage electrical failures such as arcs to ground at several locations at the high voltage end of the system and in the load circuit occurred. Nozzle erosion and significant electrode cap ablation near the channel inlet were also observed. DOE

N81-22542# General Electric Co. Schenectady, N.Y. Fuel Cell Program Office

MOLTEN CARBONATE FUEL CELL LARGE STACK DEVELOPMENT

L. J. Degan, Jun 1980, 187 p, refs

(NYSERDA-80-17) Avail NTIS HC A09/MF A01

The development of molten carbonate fuel cell (MCFC) power plants is described. Possible electrode materials were evaluated for chemical stability and conductivity. Dual porosity electrodes and the electrodeless plating of nickel on SrTiO_3 for electrode material were investigated. The requirements and recommendations of four major utilities and three industrial plants are summarized. Two coal gasifiers for use in a large coal fired MCFC plant were evaluated. The stack configurations are defined and the preliminary design of a fuel cell stack using internal manifolds and counterflow of the fuel and oxidant is presented. Specifications, drawings, and materials recommendations are included. J. D. H.

N81-22563# San Diego Gas and Electric Co., Calif.
GEOTHERMAL LOOP EXPERIMENTAL FACILITY Final Report

Apr 1980, 715 p, refs

(Contract DE-AC03-76ET-28443)

(DOE/ET-28443/T1) Avail NTIS HC A99/MF A01

In 13,000 hours of operation over a three and one half year period, the nominal 10 megawatt electrical equivalent GLEF provided the opportunity to identify problems in working with highly saline geothermal fluids and to develop solutions that could be applied to a commercial geothermal power plant producing electricity. A seven and one half year period beginning in April 1972, with early well flow testing and ending in September 1979, with the completion of extensive facility and reservoir operations is covered. During this period, the facility was designed, constructed and operated in several configurations. A comprehensive reference document addressing or referencing documentation of all the key areas investigated is presented. DOE

N81-22565# Kansas Energy Office, Topeka
KANSAS HYDRO-POWER: AN ASSESSMENT OF LOW-HEAD HYDROELECTRIC OPPORTUNITIES

Thomas Hochstetler, 2 Jan 1981, 26 p, refs

(Contract DE-FG47-80R-701055)

(DOE/R7-01055/T1) Avail NTIS HC A03/MF A01

The results of a recent survey of existing dams in Kansas to determine their respective development potentials for hydroelectricity generation are described. Of over 5,000 dams in Kansas, 34 were found to have potential for commercial development based upon such parameters as head height, flow rate, seasonal flow variations, and present state of repair. These 34 sites together could potentially produce 394 million kilowatt hours of renewable resource derived electricity about 1.5 percent of the electricity generated in Kansas in 1979. While statewide this would be a modest contribution, it could play an important role in local energy management. DOE

N81-22570# Brookhaven National Lab., Upton, N.Y. Electrochemical Technology Group

FUEL CELL APPLIED RESEARCH: ELECTROCATALYSIS AND MATERIALS Quarterly Report, 1 Oct. - 31 Dec 1979

S. Srinivasan, H. S. Isaacs, J. McBrean, W. E. O'Grady, H. Olander, L. J. Olmer, E. J. L. Schouler, and K. V. Kordesch, May 1980, 60 p, refs

(Contract DE-AC02-76CH-00016)

(BNL-51272) Avail NTIS HC A04/MF A01

Five types of carbon were compared as supports for platinum electrocatalysts. Experiments were conducted to determine the wetting characteristics of the carbons on the electrocatalytic activity of supported platinum for oxygen reduction. The latter was investigated by a cyclic voltammetry technique. The changes in the electrochemically active surface areas on increasing the temperature from 250 to 1350°C and after-carrying out oxygen reduction were measured from the hydrogen desorption charge in the cyclic voltammograms. Also, research on electrode kinetics in high-temperature solid electrolyte fuel cells is described. The influence of electrode material on oxygen reduction kinetics and the reaction mechanism on platinum at interfaces with solid electrolytes were investigated. DOE

N81-22579# Aeronautical Research Inst. of Sweden, Stockholm
Aerodynamics Dept.

L-180 POSEIDON: A SYSTEM CONCEPT IN VERTICAL AXIS TURBINE TECHNOLOGY, PART 2

Olle Ljungstrom, 9 Oct 1980, 33 p, refs. Presented at 3rd Intern. Symp. on Wind Energy Systems, Copenhagen, Aug 1980.

(Contract NE-5060-314)

(FFA-TN-AU-1577-Pt-2) Avail NTIS HC A03/MF A01

An offshore 20MW L-blade system with 180 m dia troposkien shaped blades was studied. The L-blade system uses two vertical curved blades mounted on a cantilever tower at a 90 deg angle relative to each other (in plane of rotation), thus forming an L looking from the top. Considerable reduction of the oscillating wind loads on the rotor-tower structure is realized in comparison with conventional two bladed Darrieus type systems. The reduced system weight and cost. Parking loads in extreme winds are also reduced favorably. Weight and cost estimates for farms of 10 or more offshore units are given. Author (ESA)

N81-22580# Aeronautical Research Inst. of Sweden, Stockholm
Structures Dept.

A COMPARISON OF RESULTS OBTAINED WITH TWO DIFFERENT METHODS FOR CALCULATION OF HORIZONTAL AXIS WIND TURBINE PERFORMANCE, PART 4

Staffan Meyjer, 6 Feb 1980, 31 p, refs

(Contract NE-5061-013)

(FFA-TN-HU-2189-Pt-4) Avail NTIS HC A03/MF A01

The turbine and flow field are described with finite element techniques. For the case of a wind turbine operating in steady uniform flow, performance and load characteristics were calculated and compared with the results from the standard computer program, WINRO, based on a combination of blade element and momentum theory. The calculations were made for a reference test case at different wind speeds. The reference unit is a 9 m radius two bladed 65 kW turbine. The results are in excellent agreement except for low wind speeds, probably because three dimensional effects are more important for low wind speeds than for high. Author (ESA)

N81-22984*# Jet Propulsion Lab., California Inst. of Tech., Pasadena

ELECTRIC VEHICLE TEST REPORT: CUTLER-HAMMER CORVETTE

Jan 1981, 146 p, refs. Sponsored by NASA

(Contracts NAS7-100 DE-AI01-78CS-54209)

(NASA-CR-164224 DOE/CS-54209/1) Avail NTIS HC A07/MF A01 CSCL 05A

Vehicles were characterized for the state of the art assessment of electric vehicles. The vehicle evaluated was a Chevrolet Corvette converted to electric operation. The original internal combustion engine was replaced by an electric traction motor. Eighteen batteries supplied the electrical energy. A controller, an onboard battery charger, and several dashboard instruments completed the conversion. The emphasis was on the electrical portion of the drive train, although some analysis and discussion of the mechanical elements are included. Tests were conducted both on the road (actually a mile long runway) and in a chassis dynamometer equipped laboratory. The majority of the tests performed were according to SAE Procedure J227a and included maximum effort accelerations, constant speed range and cyclic range. Some tests that are not a part of the SAE Procedure J227a are described and the analysis of the data from all tests is discussed. DOE

N81-23092# General Electric Co Schenectady N Y
ASSESSMENT OF GAS TURBINE EROSION VOLUME 1
ASSESSMENT OF AVAILABLE EROSION DATA
 Ralph R Boerick Delton A Grey Donald R Spriggs Robert
 G Hantman and Jing T Kuo Apr 1980 150 p refs Sponsored
 by New York State Energy Research and Development Author-
 ity
 (P881-139685 NYSERDA-80-3-1) Avail NTIS
 HC A07/MF A01 CSCL 21E

Pressurized fluidized bed combustion was studied and tested
 as an economical and environmentally acceptable approach to
 generating electricity from coal. A key feature of this concept is
 combined cycle operation in which a steam turbine is powered
 from steam tubes immersed in the fluidized bed while the hot
 combustion gases are used to drive a gas turbine. A key
 technical area is the erosion and corrosion of the gas turbine
 blades by particles and alkali salts carried by the combustion
 gases. Volume 1 summarizes the literature on the operation of
 gas turbines in environments similar to the pressurized fluidized
 bed combustion system. GRA

N81-23392# Westinghouse Electric Corp Lester Pa Power
 Generation Div
THE 100 MWe OTEC ALTERNATE POWER SYSTEMS
VOLUME 2. APPENDICES Final Report
 5 Mar 1979 301 p refs

(Contracts EG-77-C-05-1473, EG-77-C-03-1473)
 (ORO-1473-T1-Vol-2-1) Avail NTIS HC A14/MF A01

Information is presented on the design and dynamic behavior
 of the platform and cold water pipe construction and sizing
 anchoring, maintenance, and cost. The equations used to calculate
 nonequilibrium allowance in flash evaporators and the design
 and performance of the electric generator and exciter for the
 power system are included. Brief descriptions of the computer
 programs used in the design and analyses are also included. DOE

N81-23397# Electric Power Research Inst, Palo Alto Calif
 Safety and Analysis Dept
IMPACT OF OPERATIONAL EXPERIENCE ON RESEARCH
AND DEVELOPMENT

Walter B Loewenstein and Achilles G Adamantides Jan 1981
 23 p refs
 (EPRI-NP-1689-SR) Avail NTIS HC A02/MF A01

The gradual accumulation of operating experience data from
 nuclear plants is having a perceptible impact on the direction of
 research and development. Four areas where this influence is
 best manifested are identified: increased awareness of systems
 interaction, the importance of operational data for code qualifica-
 tion, a sharper focus of separate effects and the importance of
 well-defined scaled experiments. Illustrations from EPRI-sponsored
 and EPRI-conducted projects are presented. DOE

N81-23470# General Electric Co Schenectady N Y Gas
 Turbine Div
HIGH-TEMPERATURE COMBUSTION GAS TURBINE
PROGRAM

R S Rose Sep 1980 96 p refs
 (Contract DE-AC01-76ET-10340)

(NYSERDA-80-12) Avail NTIS HC A05/MF A01

Specific objectives are to investigate heat transfer erosion
 corrosion and deposition characteristics of selected bucket internal
 cooling channel configurations perform design analysis and
 fabricate part scale turbine buckets having design features similar
 to those applicable to a full scale heavy duty gas turbine and
 perform design analysis and investigations related to the
 application of the above elements of work to a part scale turbine
 development rig test and to a full scale utility gas turbine test
 vehicle. DOE

N81-23471# General Electric Co Schenectady N Y Gas
 Turbine Div

HIGH-RELIABILITY GAS TURBINE COMBINED-CYCLE
DEVELOPMENT PROGRAM PHASE 1. SUMMARY

R G Kunkel Jan 1981 70 p 2 Vol

(EPRI Proj 1187-3)

(EPRI-AP-1681-SU) Avail NTIS HC A04/MF A01

Tradeoff studies of reliability versus cost performance, firing
 temperature and other parameters formed the basis for all major
 design approaches and decisions in the conceptual design of a

gas turbine combined-cycle plant. The inherent reliability a,
 defined by field data, was used as a basis from which to predict
 the expected reliability and power cost of a variety of near term
 conceptual gas turbine hardware and cycle configurations. Results
 indicate that the highest reliability, the lowest power cost and
 greatest fuels flexibility may not be found within one configuration.
 The gas turbine was conceptually developed around a 19850 F
 (10850 C) firing temperature cycle. The total plant was developed
 using maintainability serviceability and the potential need for
 conversion to coal-derived fuels and other duty cycles. The controls
 and accessories were found to provide cost effective changes
 and modifications. DOE

N81-23598*# Westinghouse Electric Corp Pittsburgh Pa
 Advanced Energy Systems Div

MOD-OA 200 KW WIND TURBINE GENERATOR ENGI-
NEERING Final Engineering Drawing Report

T S Andersen, C A Bodenschatz, A G Eggers P S Hughes
 and R F Lampe Aug 1980 246 p

(Contract DEN3-183)

(NASA-CR-165129, DOE/NASA/O163-3 AESD-TME-3053)

Avail NTIS HC A11/MF A01 CSCL 10B

Engineering drawings and the detailed mechanical and
 electrical design of a horizontal-axis wind turbine designed for
 DOE at the NASA Lewis Research Center and installed in Clayton,
 New Mexico are discussed. The drawings show the hub, pitch
 change mechanism, drive train, nacelle equipment, yaw drive
 system tower foundation electrical power systems and the
 control and safety systems. A R H

N81-23600*# Energy Research Corp, Danbury Conn
EVALUATION OF DISTRIBUTED GAS COOLING OF
PRESSURIZED PAFC FOR UTILITY POWER GENERATION
Quarterly Report, Dec 1980 - Feb 1981

M Farooque M Hooper and H Maru Mar 1981 19 p

(Contract DEN3-201 Contract DE-AL03-80ET-17088)

(NASA-CR-165303, DOE/NASA/O201/2) Avail NTIS
 HC A02/MF A01 CSCL 10B

A proof-of-concept test for a gas-cooled pressurized phos-
 phoric acid fuel cell is described. After initial feasibility studies
 in short stacks, two 10 kW stacks are tested. Progress includes
 (1) completion of design of the test stations with a recirculating
 gas cooling loop (2) atmospheric testing of the baseline stack. S F

N81-23603*# Jet Propulsion Lab, California Inst of Tech,
 Pasadena

POTENTIAL IMPACTS OF BRAYTON AND STIRLING CYCLE
ENGINES

R C Heft 15 Nov 1980 151 p refs

(Contracts NAS7-100 DE-AL01-76CS-51011)

(NASA-CR-164278, JPL-Pub-81-22)

Avail NTIS

HC A08/MF A01 CSCL 10B

Two engine technologies (Brayton cycle and Stirling cycle)
 are examined for their potential economic impact and fuel
 utilization. An economic analysis of the expected response of
 buyers to the attributes of the alternative engines was performed.
 Hedonic coefficients for vehicle fuel efficiency performance and
 size were estimated for domestic cars based upon historical data.
 The marketplace value of the fuel efficiency enhancement provided
 by Brayton or Stirling engines was estimated. Under the
 assumptions of 10 years for plant conversions and 1990 and
 1995 as the introduction data for turbine and Stirling engines
 respectively the comparative fuel savings and present value of
 the future savings in fuel costs were estimated. J D H

N81-23610*# National Aeronautics and Space Administration
 Lewis Research Center Cleveland, Ohio

PRELIMINARY INVESTIGATION OF ACOUSTIC OSCILLA-
TIONS IN AN H2-O2 FIRED HALL GENERATOR

Bert Phillips 1981 13 p refs Presented at the 19th Symp
 on the Eng Aspects of Magnetohydrodyn, Tullahoma, Tenn
 15-17 Jun 1981

(Contract DE-AL01-77ET-10769)

(NASA-TM-81756, DOE/NASA/10769-15 E-819) Avail
 NTIS HC A02/MF A01 CSCL 10A

Burner pressure oscillations and interelectrode voltage
 oscillations measured in an open-cycle supersonic flow Hall
 generator are presented. The ionized gas for the channel was
 supplied by seeding the approximately 1 lb/sec of hydrogen-

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oxygen combustion products with cesium. Since both the burner and the channel were located within magnetic fields exceeding 4 Tesla during operation, an infinite probe pressure measurement technique was used to measure burner pressure oscillations. Calibration of the burner pressure transducer using a resonance tube technique is presented. Evidence is presented for the existence of the first longitudinal mode of oscillations (5000 Hz) within the burner interelectrode voltage oscillations were simultaneously measured at two separate axial stations. The magnitude change and the phase shift between the two signals was interpreted as a decaying magnetoacoustic wave driven by the burner that propagates at local gas plus sonic velocities. The amplitude of the electrical voltage oscillations at the start of the power producing region of the channel varied with the magnetic field. This variation is compared with the results of a simple perturbation analysis. Arguments are presented for using an unsteady model for analyzing wave processes in channels. Author

N81-23611* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
ASSESSMENT OF DISK MHD GENERATORS FOR A BASE LOAD POWERPLANT

Donald L. Chubb, F. D. Retallick (Westinghouse Electric Corp., Pittsburgh), C. L. Lu (Westinghouse Electric Corp., Pittsburgh), M. Stella (Westinghouse Electric Corp., Pittsburgh), J. D. Teare (MIT), W. J. Loubisky (MIT), J. F. Louis (MIT), and B. Misra (MIT). 1981. 17 p. refs. Presented at the 19th Symp. on Engr. Aspects of Magnetohydrodyn., Tullahoma, Tenn., 15-17 Jun 1981.

(Contract DE-AI01-77ET-10769)

(NASA-TM-82609, DOE/NA50/10769-17, E-849). Avail NTIS HC A02/MF A01 CSCL 10A

Results from a study of the disk MHD generator are presented. Both open and closed cycle disk systems were investigated. Costing of the open cycle disk components (nozzle, channel, diffuser, radiant boiler, magnet, and power management) was done. However, no detailed costing was done for the closed cycle systems. Preliminary plant design for the open cycle systems was also completed. Based on the system study results, an economic assessment of the open cycle systems is presented. Costs of the open cycle disk components are less than comparable linear generator components. Also, costs of electricity for the open cycle disk systems are competitive with comparable linear systems. Advantages of the disk design simplicity are considered. Improvements in the channel availability or a reduction in the channel lifetime requirement are possible as a result of the disk design. Author

N81-23644* Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho

ANALYSES OF MIXED-HYDROCARBON BINARY THERMODYNAMIC CYCLES FOR MODERATE-TEMPERATURE GEOTHERMAL RESOURCES

O. J. Demuth. Feb 1981. 22 p. refs. Prepared in cooperation with Idaho National Engineering Lab., Idaho Falls.

(Contract DE-AC07-76ID-01570)

(EGG-PG-G-80-041). Avail NTIS HC A02/MF A01

Both boiling and supercritical shell-and-tube cycles were considered. The performance of a dual-boiling isobutane cycle supplied by a 280 F hydrothermal resource (corresponding to the 5 MW pilot plant at the Raft River site in Idaho) was selected as a reference. To investigate the effect of resource temperature on the choice of working fluid, several analyses were conducted for a 360 F hydrothermal resource which is representative of the Heber resource in California. The hydrocarbon working fluids analyzed included methane, ethane, propane, isobutane, isopentane, hexane, heptane, and mixtures of those pure hydrocarbons. For comparison, two fluorocarbon refrigerants were also analyzed. DOE

N81-23651* United Technologies Corp., South Windsor, Conn.
Power Systems Div.

MOLTEN CARBONATE FUEL CELL SYSTEM VERIFICATION AND SCALE-UP. Interim Report

J. M. King and C. A. Reiser. Jan 1981. 74 p. refs. Sponsored by Electric Power Research Inst.

(EPRI Proj. 1273-1)

(EPRI-EM-1481). Avail NTIS HC A04/MF A01

The primary goal is to demonstrate the operability of a molten carbonate cell stack, an advanced fuel processor, and critical system components in a subscale power plant context. Technical tasks include testing a nominal 2 kW stack of the configuration resulting from other EPRI sponsored work (RP114-2) and testing a nominal 2 kW stack design at elevated pressures, drawing from the process development and design activities being carried out in complementary projects. DOE

N81-23687* Sandia Labs., Albuquerque, N. Mex.
Geo Energy Systems Analysis Div.

PRELIMINARY ANALYSIS OF TWO ASPECTS OF MAGMA-POWERED ELECTRIC-GENERATION PLANTS

Eddie R. Hoover. Sep 1980. 26 p. refs.

(Contract DE-AC04-76DP-00789)

(SAND-80-1522). Avail NTIS HC A03/MF A01

Two aspects critical to the development of magma electric generation plants using closed heat exchanger systems are addressed. The heat transfer between the cold fluid in the downcomer and the hot fluid in the upcomer is analyzed using an NTU-effectiveness technique. The results indicate the hot fluid must be thermally insulated from the colder fluid in order to yield a useful temperature difference at the surface. A preliminary system analysis is conducted to determine the well cost requirements of an economically competitive magma electric plant. There is no economic incentive to make the magma tap wellbore larger than conventional deep gas wells. The cost competitiveness of a magma/electric plant is influenced by the depth to the magma, the convective heat flux of the magma, and the expected life of each well. DOE

N81-23694* General Electric Co., Schenectady, N. Y.
Energy Systems Progress Dept.

FUEL CELL POWER PLANT INTEGRATED SYSTEMS EVALUATION. Final Report

T. L. Bonds, M. H. Dawes, A. W. Schnacke, and L. W. Spradlin. Jan 1981. 261 p. Sponsored by Electric Power Research Inst. (EPRI Proj. 1085-1).

(EPRI-EM-1670). Avail NTIS HC A12/MF A01

Power plant configurations for a central station (675 MW) fueled by coal and small dispersed plan generation plants fueled by oil were defined. Capital costs and costs for electricity were evaluated for both plants. Parametric variations and the impact on plants and components are discussed. Alternate oil fueled oil fired cycles as well as several alternate coal gasifiers were examined to show effects on plant performance. The economic attractiveness of the coal fired plant was confirmed and a scenario is established for an oil fired plant with reject heat recovery. Performance for the coal fired plant exceeds the study goal of 6800 Btu/kWh. The oil fired plant performance of 7627 Btu/kWh is very close to the study goal of 7500 Btu/kWh. The development of a finite slice computer model of the carbonate fuel cell is reported and an initial parametric cell and plant performance study was performed using the model. Preliminary subsystem description sheets and plant layout arrangements are presented. DOE

N81-23700* Department of Energy, Washington, D. C.
Office of Nuclear Reactor Programs

US CENTRAL STATION NUCLEAR ELECTRIC GENERATING UNITS. SIGNIFICANT MILESTONES, STATUS AS OF OCTOBER 1, 1980

Dec 1980. 43 p.

(DOE/NE-0030/4(80)). Avail NTIS HC A03/MF A01

Lists of the nuclear power units according to state, region, and utility are presented. A tabulation of status, schedules, and orders is also included. DOE

N81-23708* General Electric Co., St. Petersburg, Fla.
MOLTEN CARBONATE FUEL CELL LARGE STACK DEVELOPMENT. Final Report, May 1979 - Jun 1980

Lawrence J. Degan. Jun 1980. 202 p. refs. Sponsored by New York State Energy Research and Development Authority, Albany.

(PB81-145930, NYSERDA-80-17)

Avail NTIS HC A10/MF A01 CSCL 10B

The fuel cell promised to be a very efficient and economically and environmentally attractive way to convert the energy contained

in coal to electricity. The cell could be used for base load power generation. It could also be placed in urban settings to provide locally-needed power to stabilize voltage transients to minimize the need for additional electric transmission lines into cities and to provide co-generated heat. This project gave specific consideration to electrode development, stack configuration, New York State applications and the applicability of New York-made gasifiers. GRA

N81-23902# Stanford Univ. Calif. High Temperature Gasdynamics Lab

HIGH MAGNETIC FIELD MHD GENERATOR PROGRAM
Annual Report, 1 Oct 1979 - 30 Sep 1980

Oct 1980 204 p refs

(Contract DE-AC01-80ET-15611)

(DOE/ET-15611/3) Avail NTIS HC A10/MF A01

The MHD channel phenomena which are important at high magnetic fields are investigated. Nonuniformity effects, boundary layers, Hall field breakdown, the effects on electrode configuration and current concentrations, and studies of steady state combustion disk and linear channels in an existing 6 Tesla magnet of small dimensions are discussed. In the study of the effects of nonuniformities and instabilities, theoretical models were developed and tested against available data. Boundary layer measurements and calculations of velocity, temperature and electron density were systematically assessed by accounting for the effect of free stream turbulence. Good agreement is obtained between measurement and theory. An improved laser Doppler anemometer was developed for turbulence damping and velocity profile measurements. DOE

N81-23908# Argonne National Lab., Ill.

GPSAP/V2 WITH APPLICATIONS TO OPEN-CYCLE MHD SYSTEMS

Howard K. Geyer, Jan 1981, 235 p refs

(Contract W-31-109-eng-38)

(ANL/MHD-80-15) Avail NTIS HC A11/MF A01

A systems analysis technique for analyzing lumped component systems is presented. The computer coding is generated by employing simple preprocessor statements to establish system configurations, constraints, and objective functions. A hybrid equation solver and a sequential programming method for solving constrained optimization problems are described. Recursive calling capabilities are used in both equation solver and optimizer. The build up of Jacobians and Hessians of the constraints and objective functions are retained, reducing computing time during parameter studies. A collection of simple first order models for analysis of open cycle magnetohydrodynamics (MHD) power plant applications is presented. Simple MHD system configurations are presented and analyzed. J D H

N81-24445# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

A GAS-TO-HYDRAULIC POWER CONVERTER Patent Application

Charles Wesley Galloway, inventor (to NASA), Filed 27 Feb 1981, 13 p

(NASA-Case-MSC-18794-1 US-Patent-Appl-SN-238785) Avail NTIS HC A02/MF A01 CSCL 131

A gas piston driven hydraulic piston pump with a high efficiency gas cycle which injects the gas in slugs at the beginning of each power stroke is discussed. The hydraulic piston is disposed to operate inside the gas piston and the two pistons which are both slidably but nonrotatably mounted are coupled together with a rotating but nonsliding motion transfer ring extending into antifriction grooves in the sidewalls of the two pistons. To make the hydraulic piston move at a constant speed during constant hydraulic horsepower demand, grooves are machined with variable and opposite pitches. The motion transfer ring is denominated a force multiplier ring. It is concluded that any number of piston assembly sets may be used to obtain desired hydraulic horsepower. NASA

N81-24528# Thermo Electron Corp., Waltham, Mass.

NASA-OAST/JPL HIGH EFFICIENCY THERMIONIC CONVERSION STUDIES Executive Summary Report

Mar 1981, 57 p refs. Prepared for JPL

(Contract JPL-955009)

(NASA-CR-164343, TE4247-193-81, JPL-9950-539) Avail NTIS HC A04/MF A01 CSCL 10A

Efforts were made to develop a thermionic energy conversion TEC technology appropriate for nuclear electric propulsion missions. This space TEC effort was complementary to the terrestrial TEC studies sponsored by the Department of Energy which had the goal of topping fossil fuel power plants. Thermionic energy conversion was a primary conversion option for space reactors because of its (1) high operating temperature, (2) lack of moving parts, (3) modularity, (4) established technology, and (5) development potential. R C T

N81-24539# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

LIGHTNING ACCOMMODATION SYSTEMS FOR WIND TURBINE GENERATOR SAFETY

H. Bankatis, 1981, 16 p refs. Proposed for presentation at the 5th Intern. System Safety Conf., Denver, 26-31 Jul 1981. (Contract DE-A101-76ET-20320)

(NASA-TM-82601, DOE/NASA/20320, 31 E-848) Avail NTIS HC A02/MF A01 CSCL 10B

The wind turbine safety program identifies the naturally occurring lightning phenomenon as a hazard with the potential to cause loss of program objectives, injury to personnel, damage to system instrumentation, structure or support equipment, and facilities. Several candidate methods of lightning accommodation for each blade were designed, analyzed, and tested by submitting sample blade sections to simulated lightning. Lightning accommodation systems for composite blades were individually developed. Their effectiveness was evaluated by submitting the systems to simulated lightning strikes. The test data were analyzed and system designs were reviewed on the basis of the analysis. This activity is directed at defining design and procedural constraints, requirements for safety devices and warning methods, special procedures, protective equipment and personnel training. T M

N81-24542# Georgia Inst. of Tech., Atlanta, School of Civil Engineering

JET ENTRAINMENT IN PUMPED-STORAGE RESERVOIRS Final Report

Philip J. W. Roberts, Mar 1981, 68 p refs

(Contract DACW39-79-M-2846)

(AD-A098156, WES-TR-E-81-3)

Avail NTIS

HC A04/MF A01 CSCL 08/8

A literature review was made in order to recommend a mathematical model to predict jet entrainment in pumped-storage reservoirs. It was found that because of the many different types of inflow situations possible, no one mathematical model would be adequate in all cases. It is recommended that each flow situation be classified and entrainment be predicted for each situation by means of techniques presented in the report. The flows are classified according to the source geometry, source buoyancy, ambient stratification, and degree of submergence. A primary and secondary classification scheme resulted in 16 possible flow types. Each situation is reviewed separately and a method for predicting entrainment is presented. To use the results, judgment must first be used to classify the flow under consideration and the appropriate technique for that class of flows used. If some of the flows discussed are prevalent or of particular interest, they could be investigated in more depth and mathematical models of those developed. Author (GRA)

N81-24547# Brobeck (William M.) and Associates, Berkeley, Calif.

REVIEW OF CURRENT STATUS OF HIGH FLUX HEAT TRANSFER TECHNIQUES VOLUME 1 TEST AND APPENDIX A

A. Bauer, H. S. Gordon, H. Lackner, and J. R. Mettling, Sep 1980, 164 p refs. Prepared for California Univ., Livermore, Lawrence Livermore Lab.

(Contract W-7405-eng-48)

(UCRL-15321-Vol-1, WMB/A-4500-95-27, 20-R1-Vol-1) Avail NTIS HC A05/MF A01

High heat flux technology is reviewed with consideration given to heat transfer panel configuration, diagnostics techniques, and coolant supply. The technology offering the least uncertainty for scale up for the fusion energy research requirements is recommended. DOE

N81-24580# Gilbert/Commonwealth, Reading, Pa.

PRELIMINARY ANALYSIS OF 500 MWt MHD POWER

05 ENERGY CONVERSION

PLANT WITH OXYGEN ENRICHMENT Final Report

Apr 1980 59 p refs

(Contracts DE-AC01-77ET-11058, ET-78-C-01-2688)

(GAI-2075-A) Avail NTIS HC A04/MF A01

An MHD Engineering Test Facility design concept is analyzed. A 500 MWt oxygen enriched MHD topping cycle integrated for combined cycle operation with a 400 MWe steam plant is evaluated. The MHD cycle uses Montana Rosebud coal and air enriched to 35 mole percent oxygen preheated to 1100 F. The steam plant is a 2535 psia/1000 F/1000 F reheat recycle that was scaled down from the Gilbert/Commonwealth Reference Fossil Plant design series. Integration is accomplished by blending the steam generated in the MHD heat recovery system with steam generated by the partial firing of the steam plant boiler to provide the total flow requirement of the turbine. The major MHD and steam plant auxiliaries are driven by steam turbines. When the MHD cycle is taken out of service the steam plant is capable of stand-alone operation at turbine design throttle flow. This operation requires the full firing of the steam plant boiler. A preliminary feasibility assessment is given, and results on the system thermodynamics construction scheduling, and capital costs are presented. DOE

N81-24582# Westinghouse Electric Corp Pittsburgh Pa
Advanced Energy Systems Div

MHD GENERATOR ELECTRODE DEVELOPMENT Quarterly Report, Oct - Dec 1980

John W Sadler Laurence H Cadoff Don L Dietrick, James A Dilmore Edsel W Frantti Dave Jacobs Edgar L Kochka Jack A Kuszyk, S K Lau, and Joseph Lampert Jan 1981 91 p refs

(Contract DE-AC01-79ET-15529)

(DOE/ET-15529/9) Avail NTIS HC A05/MF A01

This program is directed towards the engineering development of cold metallic electrodes which are alternatives to the use of platinum as an anode clad material for MHD generators. Results of continuing laboratory screening tests are presented. Improvements in the anode arc test methodology and test setup which resulted in improved reproducibility as well as test simplification, are discussed. Laboratory electrochemical corrosion testing was initiated using aqueous and molten salts as the aggressive constituent in the electrolyte. Initial results from these tests are reported. On the basis of these test results, electrochemical corrosion tests using a molten salt are preferred. DOE

N81-24926*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

CONCEPTUAL DESIGN OF THE MHD ENGINEERING TEST FACILITY

D J Bents, R W Bercaw, J A Burkhart, T S Mroz, H S Rigo, C V Pearson (Argonne National Lab, Ill), D K Warriner (Argonne National Lab, Ill), A M Hatch (MIT, Cambridge), M Borden (Gilbert Associates, Inc Reading, Pa), D A Giza (Gilbert Associates, Inc, Reading, Pa) et al 1981 15 p refs Presented at the 19th Symp on Eng Aspects of Magnetohydrodyn Tullahoma, Tenn, 15-17 Jun 1981

(Contracts DE-AI01-77ET-10769, EF-77-A-01-2674)

(NASA-TM-82621, DOE/NASA/10769-18; E-872) Avail NTIS HC A02/MF A01 CSCL 201

The reference conceptual design of the MHD engineering test facility a prototype 200 MWe coal-fired electric generating plant designed to demonstrate the commercial feasibility of open cycle MHD is summarized. Main elements of the design are identified and explained, and the rationale behind them is reviewed. Major systems and plant facilities are listed and discussed. Construction cost and schedule estimates are included and the engineering issues that should be reexamined are identified. A R H

N81-24927*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

A MHD CHANNEL STUDY FOR THE ETF CONCEPTUAL DESIGN

S Y Wang, P J Staiger and J Marlin Smith 1981 13 p refs Presented at the 19th Symp on Eng Aspects of Magnetohydrodyn, Tullahoma, Tenn, 15-17 Jun 1981

(Contract DE-AI01-77ET-10769)

(NASA-TM-81764, DOE/NASA/10769-14 E-827) Avail NTIS HC A02/MF A01 CSCL 201

The procedures and computations used to identify an MHD channel for a 540 mW(l) EFT-scale plant are presented. Under

the assumed constraints of maximum $E(x)$, $E(y)$, $J(y)$ and β results show the best plant performance is obtained for active length, L is approximately 12 M whereas in the initial ETF studies L is approximately 16 M. As MHD channel length is reduced from 16 M, the channel enthalpy extraction falls off, slowly. This tends to reduce the MHD power output, however, the shorter channels result in lower heat losses to the MHD channel cooling water which allows for the incorporation of more low pressure boiler feedwater heaters into the system and an increase in steam plant efficiency. The net result of these changes is a net increase in the overall MHD/steam plant efficiency. In addition to the sensitivity of various channel parameters the trade-offs between the level of oxygen enrichment and the electrical stress on the channel are also discussed. A R H

N81-24928# Naval Postgraduate School, Monterey, Calif AN INVESTIGATION OF PLASMA SURFACE INTERACTIONS ON SELECTED CONDUCTORS AND INSULATORS M S Thesis

Joseph Henry Barker and Robert Jacques Rush Dec 1980 108 p refs

(AD-A098084) Avail NTIS HC A06/MF A01

Damage caused by plasma surface interactions is of concern in fields involving the use of such plasma devices as particle beam weapons, high power lasers and controlled thermonuclear fusion reactors. Several conductors and nonconductors were exposed to a plasma to study the plasma surface interaction damage. In one part of the study, the plasma was induced by irradiating the surface of the samples with a Q switched neodymium laser. Some of the samples were irradiated in air, at atmospheric pressure, and in a vacuum, to compare the difference in the extent of the damage on the same types of samples at different pressures. In the other part of the study, several titanium coated conductors and titanium coated nonconductors were exposed to the plasma of a Tokamak. Both the metal conductors in the first part of the study, and the titanium coatings in the second part of the study, were damaged by unipolar arcing. Nickel showed less evidence of unipolar arcing damage than any of the other samples studied. GRA

N81-24994*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

SYSTEM SAFETY IN STIRLING ENGINE DEVELOPMENT

H Bankaitis 1981 29 p refs Presented at the 5th Intern Systems Safety Conf, Denver, 26-31 Jul 1981

(Contract DE-AI01-77CS-51040)

(NASA-TM-82615, DOE/NASA/51040-25, E-867) Avail NTIS HC A03/MF A01 CSCL 10B

The DOE/NASA Stirling Engine Project Office has required, that contractors make safety considerations an integral part of all phases of the Stirling engine development program. As an integral part of each engine design subtask, analyses are evolved to determine possible modes of failure. The accepted system safety analysis techniques (Fault Tree, FMEA, Hazards Analysis etc) are applied in various degrees of extent at the system, subsystem and component levels. The primary objectives are to identify critical failure areas to enable removal of susceptibility to such failures or their effects from the system and to minimize risk. T M

N81-25485 De Langen (L H), Gooreind (Belgium)

EXAMINATION OF POSSIBILITIES TO IMPROVE ENERGY-PRODUCTION BY MAKING USE OF THE COLD AIR AT HIGH LEVEL OF THE ATMOSPHERE

L H DeLangen Aug 1979 62 p refs 3 Vol

(Rept-3) Copyright Avail Issuing Activity

The design of the wall of a tower with a diameter of 500 m and a height of 11 km is presented. The tower is to be used for ammonia vapor transportation thus creating a large thermoelectric generator. The tubes for discharge of liquid ammonia are described. Estimates for the total amount of construction materials are given. Two major mechanical aspects in the design of the tower are considered: vibration of the tower and bending of the tower by wind forces. T M

N81-25487*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

OVERVIEW DOE/NASA AUTOMOTIVE GAS TURBINE AND STIRLING PROJECTS.

Donald G Beremand 1981 17 p Presented at the Heat

Pump Contractors Program Integration Meeting McLean Va
2-4 Jun 1981

(Contract DE-AI01-77CS-51040)

(NASA-TM-82637 DOE/NASA/51040-28 E-890) Avail
NTIS HC A02/MF A01 CSCL 10B

An overview on the progress of the automotive gas turbine and automotive Stirling engine technology projects is presented. The following items are reported: (1) formulation and execution of projects in accordance with the Auto Propulsion Research and Development Act of 1978 (2) substantive technology accomplishments and (3) future path options of the programs

E A K

N81-25490* National Bureau of Standards Washington D C
Metallurgy Div

**NON-NOBLE CATALYSTS AND CATALYST SUPPORTS FOR
PHOSPHORIC ACID FUEL CELLS** Quarterly Report, Dec
1980 - Feb 1981

A J McAlister 11 Mar 1981 19 p refs

(NASA Order C-46229-D Contract DE-AI01-80ET-17088)

(NASA-CR-165308 DOE/NASA/6229-2 QR-2) Avail NTIS
HC A02/MF A01 CSCL 10A

Four different samples of the cubic alloys W sub x-1 Ti sub x C sub 1-y were prepared and found to be active and CO tolerant. When the activities of these cubic alloys were weighted by the reciprocal of the square of the W exchange they displayed magnitudes and dependence on bulk C deficiency comparable to those of highly active forms of WC. It is concluded that they may offer important insight into the nature of the active sites on and means for improving the performance of W-C anode catalysts for use in phosphoric acid fuel cells

R C T

N81-25511# ECO Inc., Cambridge, Mass

ELECTROLYTES FOR HYDROCARBON AIR FUEL CELLS
Final Technical Report, 27 Sep 1979 - 27 Sep 1980

M Walsh F Walsh D N Crouse, and R S Morris Jan 1981
47 p refs

(Contract DAAK70-79-C-0165)

(AD-A096448) Avail NTIS HC A03/MF A01 CSCL 10/2

Perfluorocarbon acids show promise for replacing phosphoric acid in direct oxidation fuel cells. Difluoromethane diphosphonic acid was synthesized and found to have twice the ionic conductivity of phosphoric acid, thermal stability above 236 C, electrochemical stability between 0-1.0V vs RHE, low vapor pressure at 200 C and high viscosity, non-corrosive properties toward fuel cell components and high rates of electrooxidation of hydrogen and high rates of electroreduction of oxygen

T M

N81-25512# Naval Postgraduate School, Monterey Calif
**OPTIMIZATION OF A LOW DELTA T RANKINE POWER
SYSTEM** M S Thesis

Raymond C Schaubel Dec 1980 236 p refs

(AD-A098567) Avail NTIS HC A11/MF A01 CSCL 20/13

The Ocean Thermal Energy Conversion (OTEC) uses the low thermal energy potential available from ocean temperature gradients. A method is presented to analyze such systems and for this purpose a comprehensive simulation is developed. The simulation includes parasitic power requirements, losses due to interconnecting lines, and heat exchanger pressure drops. Cost functions are included and numerical optimization is employed to obtain optimal designs based upon minimum cost. The analysis is converted to a computer code and coupled to the COPES/CONMIN optimization code to facilitate a fully automated design where the computer makes the design decisions and performance trade-off studies. The final product is an optimum power system module design for the designated net electrical output required and the specified system and design constraints. Preliminary results are presented for a range of system power levels. Optimum designs are obtained and compared for systems in which either titanium or aluminum tubes are used in the heat exchangers

GRA

N81-25532# Institute of Gas Technology, Chicago Ill IIT
Center

**EFFECTS OF SULFUR-CONTAINING GASES ON THE
PERFORMANCE OF MOLTEN CARBONATE FUEL CELLS**
Interim Report

T E Tang, T D Claar, and L G Mananowski Feb 1981
48 p refs

(EPRI Proj 1085-2)

(EPRI-EM-1699) Avail NTIS HC A03/MF A01

The effects of low level sulfur impurities occurring as H₂S or COS in low Btu fuel gas and as SO₂ in the oxidant gas were studied. Cell performance responses to low sulfur excursions in fuel and/or oxidant are studied. Open circuit voltage is not affected by low levels of sulfur and all performance loss occurs at the anode. For low Btu fuel inlet compositions a 10 mV loss per ppm H₂S at 160 mA/sq cm can be expected and higher performance losses will occur under anode outlet conditions. The anode performance loss resulting from H₂S is smaller at temperatures above the normal 6500 C operating temperature. The performance loss resulting from SO₂ in the oxidant is more severe than that from the same level of H₂S in the fuel. Performance losses are recovered after removal of sulfur from either fuel or oxidant

DOE

N81-25552# Naval Postgraduate School Monterey Calif
**PERFORMANCE OF AN EHD POWER GENERATOR WITH
A TWO-FLUID EJECTOR** Final Report

T H Gawain and Oscar Biblarz Jan 1981 85 p refs

(Contract ER-78-A-03-2122)

(AD-A098583, NPS-80-004) Avail NTIS HC A05/MF A01
CSCL 10/2

A detailed analysis and method of calculation is presented for determining the complete thermodynamic cycle of a two-fluid electrohydrodynamic (EHD) power generator. The analysis takes fully into account the compressibility of the media. Parameters are included which express the thermodynamic losses in the various components of the overall system. The severe restriction on output created by the electrical breakdown limit of the medium is clearly shown. The method for computing the net-electrical work output per unit mass of primary fluid and the net overall thermal efficiency of the system is carefully developed. A sample output together with the FORTRAN program are included

GRA

N81-25554# United Technologies Corp., South Windsor Conn
ADVANCED-TECHNOLOGY FUEL-CELL PROGRAM Final
Report

J A S Bett, C A Bushnell and R F Buswell Electric Power
Research Inst Mar 1981 239 p refs Sponsored by Electric
Power Research Inst

(EPRI Proj 114)

(EPRI-EM-1730) Avail NTIS HC A11/MF A01

The development of molten carbonate fuel cells and advanced phosphoric acid fuel cells is summarized. Increased liquid fuels and coal fuel capabilities are discussed. Various power conditioning systems are described

T M

N81-25555# United Technologies Corp., South Windsor Conn
ADVANCED-TECHNOLOGY FUEL-CELL PROGRAM Sum-
mary Report

J A S Bett, C A Bushnell and R F Buswell Electric Power
Research Inst Mar 1981 39 p Sponsored by Electric Power
Research Inst

(EPRI Proj 114)

(EPRI-EM-1730-SY) Avail NTIS HC A03/MF A01

Descriptions of fuel cell power plants used for utility application are presented. The suitability of initial power plant technology was examined. Developments in molten carbonate and advanced phosphoric acid fuel cells are reported. Improved fuel capabilities and power conditioning investigations are summarized

T M

N81-25559# Sandia Labs., Albuquerque, N Mex
**VERTICAL-AXIS WIND-TURBINE DRIVE-TRAIN TRAN-
SIENT DYNAMICS**

D B Clauss and T G Carne Mar 1981 51 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-2646) Avail NTIS HC A04/MF A01

Development and testing of a computer code for predicting drive train behavior at different loading conditions for a vertical axis wind turbine is described. The code is based on a lumped parameter model of the drive train. Testing for the low cost 17 meter wind turbine is described. Prediction of the effect of a slip clutch on transient torque oscillations demonstrates that a slip clutch located between the motor and brake can reduce peak torques by 38 percent

DOE

N81-25567# Brookhaven National Lab Upton, N Y
**FUEL-CELL APPLIED RESEARCH ELECTROCATALYSIS
AND MATERIALS** Quarterly Report, 1 Jan - 31 Mar 1980

05 ENERGY CONVERSION

S Srinivasan H S Isaacs J McBreen W E OGrady, H Olender, L J Olmer, E J L Schouler, and K V Kordesch Sep 1980 28 p refs

(Contract DE-AC02-76CH-00016)

(BNL-51319) Avail NTIS HC A03/MF A01

Phosphoric acid electrolyte fuel cells and high temperature solid electrolyte fuel cells are discussed. The corrosion behavior of five furnace black carbon supports for platinum electrocatalysts in phosphoric acid was evaluated using a cyclic voltammetric technique. The electrode kinetic studies of the hydrogen oxidation and the oxygen reduction reactions on smooth platinum in phosphoric acid revealed that the entire decrease in performance of a fuel cell in this impure electrolyte is entirely due to the impurity. A mathematical model which describes the slow oxygen adsorption step is compared with the experimental polarization and impedance results of uncontaminated platinum electrodes in contact with yttria stabilized zirconia electrolytes. Attempts to explain discrepancies are made by assuming that the adsorption of oxygen followed a Langmuir and then a Frumkin adsorption isotherm. It is concluded that a site variation occurred on the electrode surface when potentials were varied in the cathodic region. DOE

N81-25844# Tetra Tech, Inc Arlington Va
ECONOMIC ANALYSIS OF WIND-POWERED REFRIGERATION COOLING/WATER-HEATING SYSTEMS IN FOOD PROCESSING Final Report

Wendy S Garling, Marc R Harper Lynn Merchant-Geuder and Michael Welch Mar 1980 150 p refs

(Contracts DE-A101-76ET-20319 EX-76-A-29-1026)

(DOE/SEA-1109-20401/81-1) Avail NTIS HC A07/MF A01

Potential applications of wind energy include not only large central turbines that can be utilized by utilities, but also dispersed systems for farms and other applications. These applications include production of hot water for rural sanitation, heating and cooling of rural structures and products, drying agricultural products, and irrigation. Types of processing plants included were meat and poultry dairy, fruit and vegetable, and aquaculture. DOE

N81-25793# Los Alamos Scientific Lab, N Mex
SPACE NUCLEAR SAFETY AND FUELS PROGRAM Progress Report, Jan 1981

S E Bronisz, comp Apr 1981 19 p refs

(Contract W-7405-eng-36)

(LA-8824-PR) Avail NTIS HC A02/MF A01

Studies related to the use of (Pu-238)O₂ in radiol isotopic power systems are described. The general purpose heat source (GPHS) module is discussed in relation to impact tests, fuel breakup, reentry tests, and GPHS compatibility and vent performance tests. Topics concerning safety technology include helium release enhanced ductility fuel and test pellets. E D K

N81-25832# Stanford Univ Calif High Temperature Gasdynamics Lab

FLUCTUATIONS IN COMBUSTION-DRIVEN MHD GENERATORS

J P Barton Aug 1980 414 p refs

(Contract DE-AC01-80ET-15611)

(DOE/ET-15611/1) Avail NTIS HC A18/MF A01

Results of an experimental and theoretical investigation of inherent fluctuations that occur within combustion-driven MHD generators are presented. The primary concern was to determine the presence and effects of axially propagating, linear hydrodynamic traveling waves of the magnetoacoustic and magnetoentropic types. The possible development of large fluctuations in high magnetic interaction MHD generators caused by hydrodynamic traveling waves propagating with increasing amplitude was considered. Experimentally time resolved measurements of pressures, electrode currents, and internal differential voltages within a laboratory scale combustion driven MHD generator facility were analyzed. Hydrodynamic traveling waves within an MHD duct were theoretically investigated by considering a first order linearization analysis of the controlling quasi one dimensional fluid and electrical equations of an MHD generator. Comparisons between experimental results and a theoretical model were in qualitative agreement. DOE

N81-26236*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio

HOSTILE ENVIRONMENTAL CONDITIONS FACING CANDIDATE ALLOYS FOR THE AUTOMOTIVE STIRLING ENGINE

Joseph R Stephens 1981 12 p refs Proposed for presentation at the Environ Degradation of Eng Mater Conf Blackburn, Va, 21-23 Sep 1981

(Contract DE-A101-77CS-51040)

(NASA-TM-82632 DOE/NASA/51040-29, E-887)

Avail NTIS HCA02/MFA01 CSCL 11F

The materials research program in support of the Automotive Stirling Engine Project focuses on the hot heater head of the engine including the heater head tubes, cylinders, and regenerator housings which are considered to be the most critical components from a materials viewpoint. The specific areas of investigation in the program involve hydrogen permeability testing, doping of the hydrogen working fluid to reduce permeability rates, oxidation/corrosion studies, creep-rupture evaluation, and assessing effects of hydrogen environment on mechanical properties. Emphasis is placed on the materials challenges that result from the use of hydrogen as the working fluid. S F

N81-26284# Stanford Univ, Calif High Temperature Gasdynamics Lab

OPTICAL DIAGNOSTIC MEASUREMENTS OF COAL-SLAG PARAMETERS IN COMBUSTION MHD SYSTEMS

Peter Carl Ariessohn Aug 1980 183 p refs

(Contract DE-AC01-80ET-15611)

(DOE/ET-15611/2 HTGL-119, EPRI-RP-468-1) Avail NTIS HC A09/MF A01

A slag layer surface position monitor employing a laser triangulation method was developed and used to measure variations in slag layer thickness as a function of substrate temperature for a variety of ash loadings and total reactant flowrates. Slag layer thickness is seen to decrease with increasing substrate temperature and plasma velocity. The measurement of mean size and concentration of suspended ash droplets in the plasma exiting the M-8 combustor was accomplished utilizing a two wavelength transmissometer developed for this purpose. This instrument incorporates several unique features which were required to overcome the difficulties imposed by the MHD environment. Measurements obtained with this device show that mean ash droplet diameter is relatively independent of ash loading combustor residence time and combustion stoichiometry, but is a decreasing function of plasma temperature. DOE

N81-26464# Energy Research Associates, Oakland, Calif
CONTINUOUS-BAND NITINOL HEAT ENGINE Final Report

A David Johnson Sep 1980 30 p refs

(Contract DE-FG03-78SF-01982, Grant EM-78-G-03-1982)

(DOE/SF-01982/T1) Avail NTIS HC A03/MF A01

The development of a nitinol heat engine which utilizes the shape-memory properties of the alloy to convert heat to mechanical energy is discussed. A fully instrumented training engine was developed for preconditioning the wires to be used in the multiple band engine. A specialized wire rolling mill was built with which a few continuous loops were fabricated starting with annular rings cut from nitinol plate. Apparatus for measuring the stress-strain temperature characteristics of naive and trained nitinol wire was modified to accommodate continuous loops. Torque versus speed curves were measured on the single wire engine. Internal forces and torques were recorded as naive wires were trained in conjunction with state surface measurements (stress, strain temperature cycles). These measurements reveal how the wires adapt to certain conditions so that power output may increase or decrease as the condition of the nitinol wire changes due to cycling, and thus change their match to the engine design. Fatigue experiments were run on several wires. The performance of a multiple band nitinol engine is documented. DOE

N81-26568# Natural Resources Corp., Brooklyn Park, Minn
USING A WIND ELECTRIC SYSTEM TO GENERATE POWER INTO A UTILITY GRID A PROJECT IN SOUTH CENTRAL RURAL MINNESOTA Final Report

Tom Griffin and Merle Tate 1981 22 p

(Contract DE-FG02-79R5-10134)

(DOE/R5-10134/1) Avail NTIS HC A02/MF A01

Design specifications are presented for the Jacobs 10 KVA wind turbine system. DOE

N81-26574# Los Alamos Scientific Lab., N Mex
**FUEL CELLS FOR AUTOMOTIVE APPLICATIONS-
 OVERVIEW**

J Byron McCormick 1980 15 p refs Presented at Elec and Hybrid Vehicle Advanced Technol Seminar, Pasadena, Calif 8 Dec 1980 Submitted for publication
 (Contract W-7405-eng-36)

(LA-UR-81-373, CONF-801242-2) Avail NTIS
 HC A02/MF A01

Projections are made of fuel cell technology for vehicular use. The fuel used to provide hydrogen to a phosphoric acid fuel cell is assumed to be methanol. Experimental performance data for a golf cart is discussed. The design economics and predicted performance for a fuel cell retrofitted x-car with lead acid batteries for peaking power are described. The technical and economic feasibility of using fuel cells in city buses, vans and passenger cars are examined. It is concluded that the fuel cell/battery hybrid vehicle will have the advantages of high efficiency, i.e., 53 percent improvement in fuel economy, long fuel cell life, performance comparable to IC engine vehicles, low maintenance, petroleum fuel conservation, low pollution, and quiet operation. From a comparison of the lifetime costs of conventional vehicles versus fuel cell vehicles, it is concluded that commercialization of fuel cells for buses is most feasible followed by van and automobile applications. DOE

N81-26578# Battelle Pacific Northwest Labs., Richland, Wash
 Atmospheric Sciences Dept
**EFFECT OF SITE WIND CHARACTERISTICS ON ENERGY
 PRODUCTION**

W T Pennell and H L Wegley Dec 1980 20 p refs Presented at the 3rd Miami Intern Conf on Alternative Energy Sources, Miami Beach Fla., 12-15 Dec 1980
 (Contract DE-AC06-76RL-01830)

(PNL-SA-9066, CONF-801210-20) Avail NTIS
 HC A02/MF A01

The effect of differences in wind characteristics on estimates of wind turbine performance is examined. Net energy production over a given period can be estimated if both the performance characteristics of the turbine and the wind speed probability density function (PDF) are known. Simulations covering a range of PDFs and machine performance characteristics showed that reasonable estimates of net energy production can be made using simple, analytical PDFs. The analytical PDFs only require knowledge of the average wind speed at a site. Some wind energy applications require knowledge of how temporal variations in turbine output interact with temporal variations in the load. The effect of variations in the diurnal modulation of wind speed on load matching was examined by simulating the energy transfer between a utility and a residence equipped with a small wind turbine generator. Turbine performance was simulated at six sites having a wide range of diurnal characteristics. DOE

N81-27054# Sandia Labs, Albuquerque N Mex
**AERODYNAMIC INTERFERENCE BETWEEN TWO DARRIEUS
 WIND TURBINES**

P R Schatzle, P C Klimas and H R Spahr Apr 1981 38 p refs

(Contract DE-AC04-76DP-00789)

(SAND-81-0896) Avail NTIS HC A03/MF A01

The effect of aerodynamic interference on the performance of two curved bladed Darrieus type vertical axis wind turbines was calculated using a vortex/lifting line aerodynamic model. The turbines have a tower-to-tower separation distance of 1.5 turbine diameters with the line of turbine centers varying with respect to the ambient wind direction. The effects of freestream turbulence were neglected. For the cases examined, the calculations showed that the downwind turbine power decrement (1) was significant only when the line of turbine centers was coincident with the ambient wind direction (2) increased with increasing tip speed ratio and (3) is due more to induced flow angularities downstream than to speed deficits near the downstream turbine. DOE

N81-27527# Sandia Labs, Albuquerque N Mex
**VERTICAL AXIS WIND TURBINE DRIVE TRAIN TRANSIENT
 DYNAMICS**

D B Clauss and T G Carne 1981 17 p refs presented at DOE/NASA Wind Turbine Dyn Workshop, Cleveland 24 Feb 1981

(Contract DE-AC04-76DP-00789)

(SAND-80-2646C CONF-810226-1) Avail NTIS
 HC A02/MF A01

Transient torque oscillations in the drive train caused by start up of a vertical axis wind turbine were studied using a computer code based on a lumped parameter model of the drive train. The program was developed and tested for the low cost 17 meter turbine. Responses for several different transient operations were predicted and possible design modifications intended to reduce transient torque levels were developed. The program is shown to be a drive train design tool to ensure safe and reliable operation of the turbine. DOE

N81-27604# National Aeronautics and Space Administration
 Lewis Research Center, Cleveland Ohio

**COMPATIBILITY OF ALTERNATIVE FUELS WITH ADVANCED
 AUTOMOTIVE GAS TURBINE AND STIRLING
 ENGINES. A LITERATURE SURVEY. Final Report**

James Cairelli and David Horvath May 1981 44 p refs

(Contract DE-AL01-77CS-51040)

(NASA-TM-81754 DOE/NASA/51040-24 E-792) Avail
 NTIS HC A03/MF A01 CSCL 10B

The application of alternative fuels in advanced automotive gas turbine and Stirling engines is discussed on the basis of a literature survey. These alternative engines are briefly described and the aspects that will influence fuel selection are identified. Fuel properties and combustion properties are discussed with consideration given to advanced materials and components. Alternative fuels from petroleum, coal, oil shale, alcohol and hydrogen are discussed and some background is given about the origin and production of these fuels. Fuel requirements for automotive gas turbine and Stirling engines are developed and the need for certain research efforts is discussed. Future research efforts planned at Lewis are described. Author

N81-27606# National Aeronautics and Space Administration
 Lewis Research Center, Cleveland Ohio

**THE MOD-2 WIND TURBINE DEVELOPMENT PROJECT
 Final Report**

Bradford S Linscott, Joann T Dennett (RDD Consultants Inc) and Larry H Gordon Jul 1981 24 p refs

(Contract DE-A101-79ET-20305)

(NASA-TM-82681 DOE/NASA/20305-5 E-965) Avail NTIS
 HC A02/MF A01 CSCL 10B

A major phase of the Federal Wind Energy Program, the Mod-2 wind turbine, a second-generation machine developed by the Boeing Engineering and Construction Co for the U.S. Department of Energy and the Lewis Research Center of the National Aeronautics and Space Administration, is described. The Mod-2 is a large (2.5-MW power rating) horizontal-axis wind turbine designed for the generation of electrical power on utility networks. Three machines were built and are located in a cluster at Goodnoe Hills, Washington. All technical aspects of the project are described: design approach, significant innovation, features, the mechanical system, the electrical power system, the control system, and the safety system. Author

N81-27623# Energy Research Corp., Danbury Conn
**AQUEOUS TRIFLUOROMETHANESULFONIC ACID FUEL
 CELLS. Final Technical Progress Report, Jun 1978 - Oct 1980**

Michael George Feb 1981 61 p refs

(Contract DAAK70-78-C-0103)

(AD-A098919 ERC-6154-F) Avail NTIS HC A04/MF A01
 CSCL 10/2

Hydrogen-air fuel cells were successfully operated with 6M TFMSA as the electrolyte at temperatures as high as 90 C. The fuel cell performance was enhanced over similarly loaded electrodes in H3PO4 due to the apparent improved kinetics for the oxygen reduction reaction. A variety of unsupported and supported Pt electrocatalysts could be effectively utilized. Subscale TFMSA fuel cells could be operated stably for periods as long as 3000 hours. Evaluation of TFMSA electrolytes in stack configurations was encouraging as acceptable initial performance levels were demonstrated. Author (GRA)

N81-27635# Midwest Research Inst., Golden Colo
 Solar Energy Research Inst.

**ANALYSIS OF THE APPLICATION OF THERMOGALVANIC
 CELLS TO THE CONVERSION OF LOW GRADE HEAT TO
 ELECTRICITY**

05 ENERGY CONVERSION

H L Chum R F Fahlsing and T S Jayadev Aug 1980 8 p
refs Presented at the 15th Intersoc Energy Conversion Eng
Conf Seattle 18-22 1980
(Contracts DE-AC02-77CH-00178 EG-77-C-01-4042)
(SERI/TP-641-849 CONF-800806-41) Avail NTIS
HC A02/MF A01

Measurements on the copper/copper formate/copper system
yield thermoelectric powers which are higher than those exhibited
by other copper systems In these solutions three copper formate
complexes are present Practical cells were built and tested
The power output is largely limited by cell resistance though
mass and charge transfer contribute to the observed overvoltages
The coupling of this thermogalvanic system with an electrochemi-
cal photovoltaic effect (a photothermogalvanic cell) is briefly
described DOE

N81-27640# Gas-Cooled Reactor Associates La Jolla Calif
**HIGH-TEMPERATURE GAS-COOLED REACTOR STEAM
CYCLE, COGENERATION APPLICATION STUDY**

Dec 1980 336 p refs

(Contract DE AC03 78SF 02034)

(DOE/SF 02034/T12) Avail NTIS HC A15/MF A01

The evaluation of the HTGR SC/C technology the evaluation
of potential HTGR-SC/C markets the assessment of the
economics of commercial HTGR-SC/C plants and the evaluation
of the program and expenditures necessary to establish
HTGR SC/C technology through the completion of the lead Project
are presented Further the value of the HTGR-SC/C Lead Project
in the support of advanced applications such as the HTGR R is
also addressed The HTGR SC/C is considered as a Lead
project candidate in two configurations a 2240-MW(t) baseload
electric plant and an 1170 MW(t) cogeneration plant that provides
electricity and process steam DOE

N81-27642# Acres American Inc Buffalo N Y
**PROJECT DESIGN CRITERIA MANUAL UPPER MECHAN-
ICVILLE HYDROELECTRIC REDEVELOPMENT PROJECT**

Dec 1980 101 p refs

(Contract DE-FC07-80ED-12117)

(DOE/RA-12117) Avail NTIS HC A06/MF A01

The design criteria presented in this manual are to be used
as the basis for the detailed design for the Upper Mechanicville
NY hydroelectric redevelopment project The manual refers to
codes and standards which are to be used in the design of the
project Design approaches not covered by existing codes and
standards are also given for all phases of the project The manual
is divided into six sections civil design hydraulic design
geotechnical design electrical systems mechanical systems and
major equipment These design criteria are to be used as a
guide for design When changes become necessary these shall
be documented by the engineer responsible for the design This
documentation shall be sent to the project engineer and project
manager for submission to the client for reference The
documentation shall specify the reason for the change and shall
be routed to all Department Coordinators DOE

N81-27645# Idaho Nuclear Corp Idaho Falls
**HYDROPOWER COMPUTERIZED RECONNAISSANCE
PACKAGE, VERSION 2.0**

C R Broadus Apr 1981 131 p refs

(Contract DE-AC07-76ID-01570)

(DOE/ID-01570/T18) Avail NTIS HC A07/MF A01

The package is a computerized preliminary engineering and
economic study package for small hydroelectric projects which
consists of three programs One engineering program evaluates
the flow characteristics of a site and determines the energy
generated for various turbine configurations and two economic
programs provide two levels of economic studies depending upon
the amount of site-specific information available An Apple II
computer is utilized to provide a quick-turnaround capability The
models and methods used in the HCR package are described
and information is provided on program application, sample run
sessions program outputs and listings of the main programs DOE

N81-27655# Kaman Aerospace Corp Bloomfield Conn
**DEVELOPMENT OF A 40-KILOWATT WIND TURBINE
GENERATOR PHASE 1 DESIGN AND ANALYSIS**
Henry E Howes, Michael A Bowes and Richmond Perley Feb

1981 296 p Prepared for Rockwell International Corp Golden
Colo

(Contract DE-AC04-76DP-03533)

(RFP-3094-2) Avail NTIS HC A13/MF A01

Kaman Aerospace Corporation is currently engaged in a
program to design fabricate and test a horizontal axis wind
turbine generator capable of producing 40 kW electrical output
power in a 20 mph wind The results covering design tradeoff
studies preliminary design and analysis and the final design
effort are presented Additional work included cost studies and
test planning activities DOE

N81-27663# SRI International Corp Menlo Park Calif
**HYDROCARBON REFORMING FOR HYDROGEN FUEL
CELLS Annual Report 1 Oct 1979 - 30 Sep 1980**

C Hart P Y Hou R M Laine J G McCarty D Sheridan H
A Wise and B J Wood 30 Jan 1981 54 p refs

(Contract DE-AC21-79MC-11323 SRI Proj PYU 1038)

(DOE/MC-11323/T1) Avail NTIS HC A04/MF A01

The mechanism of carbon formation on nickel autothermal
steam reforming catalysts was studied by temperature program-
ming thermogravimetric and electron microscopic techniques
Temperature programmed surface reaction (TPSR) studies of
carbon deposited on nickel reforming catalysts by the decomposi-
tion of ethylene exhibit seven forms of carbon that are distinguish-
ed by their characteristic reactivity with H₂ and 3.0 vol percent
H₂O/He The relative population of the different carbon states
depends primarily on the temperature during deposition The
reactivity of the carbon states are not altered by exposure to
steam in C₂H₂-H₂O mixtures but the amount of carbon deposited
decreases to zero as the H₂O/C increases past a critical ratio
Critical steam to carbon ratios were measured in the presence
of C₂H₄-H₂O mixtures so as to establish the carbon formation
boundary for several alumina supported nickel Ni Rh and Ni-Ir
alloy catalysts The critical H₂O/C ratio measured with a
gravimetric balance decreased from approx 30 at 7730 K to
approx 1 at 10730 K for all the catalysts studied DOE

N81-27668# Argonne National Lab Ill
**US/USSR COOPERATIVE PROGRAM IN OPEN-CYCLE MHD
ELECTRICAL POWER GENERATION JOINT TEST REPORT
NO 4 TESTS IN THE U-25B FACILITY MHD GENERATOR
TESTS NO 6 AND 7**

B F Picologlou ed and V M Batenin ed Jan 1981 240 p
refs

(Contract W-31-109-eng-38)

(ANL-IVTAN-JT-4) Avail NTIS HC A11/MF A01

The MHD generator was operated at its design parameters
New plasma diagnostic devices are described and include a
traversing dual electrical probe for determining distribution of
electron concentrations a traversing probe that includes a pitot
tube for measuring total and static pressure and a light detector
for measuring plasma luminescence Data are presented on heat
flux distribution along the channel the forest data of this type
obtained for an MHD facility of such size Results are given of
experimental studies of plasma characteristics gasdynamic
thermal and electrical MHD channel performance and temporal
and spatial nonuniformities DOE

N81-27669# Rockwell International Corp Golden Colo Energy
Systems Group

**CONTROLLED VELOCITY TESTING OF SMALL WIND
ENERGY CONVERSION SYSTEMS AN EVALUATION OF
A TECHNIQUE**

J C Balcerak Nov 1980 50 p refs

(Contract DE-AC04-76DP-03533)

(RFP 3189) Avail NTIS HC A03/MF A01

A test machine was mounted on a rail flatcar which was
pushed by a locomotive The primary objective of the test was
to determine the usefulness of SWECS controlled velocity testing
(CVT) using this method Wind velocity profiles acceleration/
deceleration forces, rotor yaw power output rotor rpm power
coefficient wake measurements and flow visualization were
examined in these tests The results confirm the potential benefit
of this method as an addition to the natural atmospheric testing
done at the Rocky Flats Wind Systems Test Center DOE

N81-27675# WESTEC Services, Inc Albuquerque N Mex
**BACA GEOTHERMAL DEMONSTRATION PROJECT
POWER PLANT DETAIL DESIGN DOCUMENT**

Feb 1981 106 p Sponsored in part by Union Geothermal Company of New Mexico Prepared for Public Service Company of New Mexico

{Contract DE-FC03-78ET-27163}

{DOE/ET-27163/7} Avail NTIS HC A06/MF A01

This Baca Geothermal Demonstration Power Plant document presents the design criteria and detail design for power plant equipment and systems as well as discussing the rationale used to arrive at the design Where applicable, results of in-house evaluations of alternatives are presented DOE

N81-27932# Army Military Personnel Center Alexandna Va
**INVESTIGATION OF TOKAMAK SOLID DIVERTOR TARGET
 OPTIONS M S Thesis - MIT Final Report**

John M McMurray 26 May 1981 127 p refs

{AD-A099692} Avail NTIS HC A07/MF A01 CSCL 18/5

Analysis of survival constraints on the design of solid targets for Tokamak bundle divertors is presented Previous target design efforts are reviewed Considerations of heat removal surface erosion and fatigue life are included in a generalized design window methodology which facilitates target selection Using subcooled water as coolant eight possible target materials are evaluated for use in tubular and plate targets as substrates coatings and claddings Subject to the severe environment of the Tokamak plasma the most promising conventional designs are identified A thermally bonded mechanically unbonded laminated design is proposed and evaluated as a target design well suited to the divertor target environment Due to fatigue and sputtering erosion this configuration has limited life but appears to constitute an upper bound for the capabilities of a solid target design Needs for experimental work are identified

Author (GRA)

ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc. microwave power transmission and superconducting power transmission

A81-34059 Heat stabilizing properties of gas regulated heat pipes with a soluble gas M G Semena and R Muller (Kievskii Politehnicheskii Institut, Kiev, Ukrainian SSR) (*Teplofizika Vysokikh Temperatur*, vol 18, July-Aug 1980, p 846-851) *High Temperature*, vol 18, no 4, Jan* 1981, p 658-663 8 refs Translation

A mathematical model of a gas regulated heat pipe with a soluble gas is presented and analyzed. A differential equation is derived describing the change in the vapor temperature of the heat-transfer fluid with change in heat load, the temperature of the cold source, and other independent variables. The results of the model are verified by experimental data on a heat pipe in which water is the heat transfer fluid and ammonia is the soluble gas. B J

A81-39141 * # The monogroove high performance heat pipe J Alario, R Haslett, and R Kosson (Grumman Aerospace Corp., Bethpage, NY) *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1156* 10 p Contract No. NAS9 15965

The development of the monogroove heat pipe, a fundamentally new high-performance device suitable for multi-kilowatt space radiator heat-rejection systems, is reported. The design separates heat transport and transfer functions, so that each can be separately optimized to yield heat transport capacities on the order of 25 kW/m. Test versions of the device have proven the concept of heat transport capacity control by pore dimensions and the permeability of the circumferential wall wick structure, which together render it insensitive to tilt. All cases tested were for localized, top-side heat input and cooling and produced results close to theoretical predictions. O C

A81-39220 # Investigation of transonic flow in the vapor channel of a high temperature heat pipe in the case of arbitrary heat delivery to the heating zone (issledovanie okolozvukovogo techeniya v parovom kanale vysokotemperaturnoi teplovoi trubyy pri proizvol'nom zakone podvoda teploty k zone nagreva) E N Shevchuk and N V Chistop'anova (Akademiya Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR) *Promyshlennaya Teplotekhnika*, vol 3, May-June 1981, p 52-57 in Russian

Attention is given to the operation of a high temperature heat pipe with emphasis on the transonic flow of metal vapors from the heat carrying fluid (e.g., such liquid metals as lithium and sodium). The equations of conservation of mass, energy, and momentum, together with a suitable equation of state for the vapor, are reduced to a form suitable for numerical treatment. Comparison of pressure drops along the length of the heating zone, obtained by solving the differential equations and calculated for the case of incompressible vapor, shows satisfactory agreement only for low heat flux values. P T H

A81-39282 Toluene as a working fluid in solar steam-turbine plants K V Bezruchko, N V Belan, V A Grilikhes, and M M Grishutin (*Geliotekhnika*, vol 16, no 3, 1980, p 36) *Applied Solar Energy*, vol 16, no 3, 1980, p 1-4 13 refs Translation

The thermodynamic properties of toluene as an organic working fluid (OWF) in high temperature solar powered steam turbines are studied. The density of superheated toluene vapor is compared with known characteristics of benzene, figures which prove to be in error 0.13 to 0.05% in the 380 to 570 K range. The entire range of thermophysical properties are calculated and listed. It is noted that the use of organic working fluids such as toluene, which demonstrate high saturation temperatures with low saturated vapor pressures, decreases the total amount of materials necessary for power plants, particularly metals, when compared with water. Toluene does not

form condensate on turbine blades, thus enhancing efficiency, and corrosion is absent when water or oxygen impurities are also absent. D H K

A81-40071 Lasers and energy transmission (Lasers et transmission d'énergie) A Orszag (Ecole Polytechnique, Palaiseau, Essonne, France) (*SUNSAT Energy Council and Centre National d'Etudes Spatiales, International Symposium on Solar Power Satellites, Toulouse, France, June 25, 27, 1980*) *Space Solar Power Review*, vol 2, no 1-2, 1981, p 115-126 10 refs In French

The use of a laser beam for the transmission of solar energy collected in space to ground based collectors is examined. Consideration is given to the processes involved in the solar pumping of gas or condensed-phase lasers, and in the discharge excitation of a gas laser, and it is shown that only gas discharge lasers based on CO or CO₂ exhibit high power emission with a significant efficiency. The probable configuration of such a spaceborne CO gas discharge laser with gas expansion is discussed, and the atmospheric propagation and terrestrial reception of the laser beam generated are considered. Of the types of energy collectors proposed for the reception of the laser radiation, it is noted that heat engines are capable of operating at higher efficiencies than photovoltaic, thermionic or thermoelectronic cells. A L W

N81-22305 # Centro Informazioni Studi Esperienze Milan (Italy) Documentation Services

ON AC LOSSES IN NbTi AND Nb3Al WIRES

M Asdente, G Cavalleri, and A M Ricca 1980 8 p refs Presented at 8th Intern Cryogenic Eng Conf and Exhibition Genoa 3-6 Jun 1980. Sponsored in cooperation with CNR and Ente Nazl per l'Energia Elettrica (CISE-1589) Avail NTIS HC A02/MF A01

Power losses (ac) in mono and multifilamentary Nb3Al wires with a layered structure and in monofilament NbTi wires were measured by a very sensitive electronic microwattmeter as a function of the effective current I for temperatures ranging from 4.2 K to T_{sub C}. The power loss P versus current I shows a behavior proportional to I²exp(a). For NbTi there is good agreement with Bean's model (A = 3) and there is also evidence of a surface current. For Nb3Al A is 5 at 4.2 K and tends to 3 for T tends to T_{sub C}. The multifilamentary Nb3Al wire can carry 200 A at 4.2 K about three times that of the monofilamentary wire. Author (ESA)

N81-22310 # National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

HEAT PIPES CONTAINING ALKALI METAL WORKING FLUID Patent Application

James F Morris, inventor (to NASA) Filed 16 Mar 1981 8 p (NASA-Case-LEW-12253-1, US-Patent-Appl-SN-243682) Avail NTIS HC A02/MF A01 CSCI 20D

The improvement of high temperature evaporation condensation heat transfer devices which have important and unique advantages in terrestrial and space energy processing is discussed. The device is in the form of a heat pipe comprising a sealed container or envelope which contains a capillary wick. The temperature of one end of the heat pipe is raised by the input of extremely hot and corrosive heat from an external heat source. A working fluid of a corrosive alkali metal transfers this heat to a heat receiver remote from the heat source. The container and wick are fabricated from a superalloy containing a small percentage of corrosion inhibiting or gettering element. Lanthanum, scandium, yttrium, thorium, and hafnium are utilized as the alloying metal. NASA

N81-22479 National Aerospace Lab Amsterdam (Netherlands) Spaceflight Div-

QUANTITATIVE CONSIDERATIONS CONCERNING A HIGH PERFORMANCE HEAT PIPE WITH A SHORT ELECTRO-OSMOTIC PUMPING SECTION

A A M Delil 29 Oct 1979 50 p refs (Contract NLR-1833)

(NLR-TR-79113-L) Avail Issuing Activity

Electro-osmotic pumping restricted to a short fine pore section connected in series with a normal wider pored wick with low flow resistance was studied theoretically. A heat pipe with a fully controllable heat transport capacity is thus available. A practical case was considered in which a dilute CO₂ water solution is used as a working fluid. The zero voltage performance

06 ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

and electro-osmotic figure of merit parameters are defined Zero gravity and terrestrial gravity condition examples are treated

Author (ESA)

N81-22515# Department of Energy, Washington D C Office of Competition

UNITED STATES PETROLEUM PIPELINES AN EMPIRICAL ANALYSIS OF PIPELINE SIZING

Leonard L Coburn Dec 1980 482 p
(DOE/PE-0024) Avail NTIS HC A21/MF A01

The undersizing theory hypothesizes that integrated oil companies have a strong economic incentive to size the petroleum pipelines they own and ship over in a way that means that some of the demand must utilize higher cost alternatives. The DOJ theory posits that excess or monopoly profits are earned due to the natural monopoly characteristics of petroleum pipelines and the existence of market power in some pipelines at either the upstream or downstream market. The theory holds that independent petroleum pipelines owned by companies not otherwise affiliated with the petroleum industry (independent pipelines) do not have these incentives and all the efficiencies of pipeline transportation are passed to the ultimate consumer. Integrated oil companies on the other hand keep these cost efficiencies for themselves in the form of excess profits. DOE

N81-23595*# Rockwell International Corp., Downey Calif Space Operations and Satellite Systems Div

SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY (EXHIBIT D) VOLUME 7 SYSTEM/SUBSYSTEMS REQUIREMENTS DATABOOK Final Report

G M Hanley Washington NASA Mar 1981 267 p
(Contract NAS8-32475)
(NASA-CR-3399, M-340-Vol-7 SSD-80-0108-7-Vol-7) Avail NTIS HC A12/MF A01 CSCI 10B

This volume summarizes the basic requirements used as a guide to systems analysis and is a basis for the selection of candidate Satellite Power Systems (SPS) point designs. Initially, these collected data reflected the level of definition resulting from the evaluation of a broad spectrum of SPS concepts. As the various concepts matured these requirements were updated to reflect the requirements identified for the projected satellite system/subsystem point designs. Included is an updated version of earlier Rockwell concepts using klystrons as the specific microwave power amplification approach as well as a more in-depth definition analysis and preliminary point design on two concepts based on the use of advanced solid state technology to accomplish the task of high power amplification of the 2.45 GHz transmitted power beam to the Earth receiver. Finally a preliminary definition of a concept using magnetrons as the microwave power amplifiers is presented. SF

N81-24365# ECON Inc Princeton, N J
EVALUATION OF HIGHER DISTRIBUTION AND/OR UTILIZATION VOLTAGES Final Report

G A Hazelrigg, Jr Jan 1981 41 p refs
(Contracts DE-AC01-78ET-20505, DE-AC01-78ET-2866)
(DOE/RA-20505/01) Avail NTIS HC A03/MF A01

An electric energy distribution/utilization system cost analysis model is presented for exploring cost tradeoffs and optimizing system configuration. The model focuses on the treatment of residential and light commercial service areas with time varying load characteristics, including customer load profile changes, per customer load growth, and service area population growth. Applications of the model include providing insight on the selection of primary and secondary voltages, conductor sizing, distribution transformer sizing, change out policies and copper-to-core-loss ratio, and limits on allowable voltage variation at the service entrance. Examples are provided to illustrate model capabilities. DOE

N81-24369# Centro Informazioni Studi Esperienze, Milan (Italy) Documentation Service

MEASUREMENTS OF ENERGY LOSSES IN MONOFILAMENTARY SUPERCONDUCTORS

M Asdente, G Cavallini, M C Pascucci, and A M Ricca Dec 1979 6 p refs Presented at 15th Intern Congr of Refrig., Venice, 23-29 Sep 1979 Sponsored by Ente Nazionale per l'Energia Elettrica
(CISE-1566) Avail NTIS HC A02/MF A01

The results of ac loss measurements on a multilayered Nb and Nb3Al monofilament are presented. The sample wire consisted of a multilayered Nb-Al filament structure with Nb layers 1 micron thick wound on an insulating cylinder in an antinductive configuration. The Nb3Al compound was formed using a thermal process. The measurements were done at 4.2, 7.5 and 11 K. A linear relationship in the log-log plot of power versus intensity is obtained. The exponent is monotonically decreasing with the temperature and is always higher than the value predicted by Bean's model. Author (ESA)

N81-24555# Argonne National Lab., Ill
LOAD RESEARCH MANUAL VOLUME 2 FUNDAMENTALS OF IMPLEMENTING LOAD RESEARCH PROCEDURES

Nov 1980 218 p refs 3 Vol
(Contract W-31-109-eng 38)
(ANL/SPG-13-Vol-2) Avail NTIS HC A10/MF A01

This manual will assist electric utilities and state regulatory authorities in investigating customer electricity demand as part of cost-of-service studies, rate design, marketing research, system design, load forecasting, rate reform analysis, and load management research. Load research procedures are described in detail. Research programs at three utilities are compared: Carolina Power and Light Company, Long Island Lighting Company, and Southern California Edison Company. A load research bibliography and glossaries of load research and statistical terms are also included. TM

N81-24558# Argonne National Lab., Ill
LOAD RESEARCH MANUAL VOLUME 3. LOAD RESEARCH FOR ADVANCED TECHNOLOGIES

Nov 1980 75 p refs Prepared in cooperation with Gordian Associates, Inc., New York 3 Vol
(Contract W-31-109-eng-38)
(ANL/SPG-13-Vol-3) Avail NTIS HC A04/MF A01

Technical guidelines for electric utility load research are presented. Special attention is given to issues raised by the load reporting requirements of the Public Utility Regulatory Policies Act of 1978 and to problems faced by smaller utilities that are initiating load research programs. The manual includes guides to load research literature and glossaries of load research and statistical terms. Special load research procedures are presented for solar, wind, and cogeneration technologies. DOE

N81-25319# National Bureau of Standards, Boulder, Colo Thermophysical Properties Div.

HELIUM RESEARCH IN SUPPORT OF SUPERCONDUCTING POWER TRANSMISSION Annual Report, 1 Oct. 1978 - 30 Sep 1978

D E Daney, ed Dec. 1980 59 p refs Sponsored by DOE
Prepared for Brookhaven National Lab
(PB81-158608; NBSIR-80-1637) Avail NTIS HC A04/MF A01 CSCI 08C

The development of a fundamental understanding of the counter flow method of the superconducting power transmission line (SPTL) cool down is reported. It is emphasized that the analytical, numerical, and experiments results accurately model the cool down of full scale SPTL's. The cable permeability measurements indicate that any significant rupture of the lead gas barrier of the cable will lead to an unacceptable high leak rate from the pressurized core. EAK

N81-26364 Pittsburg Univ Pa
TRANSIENT SIMULATION OF SUPERCONDUCTING SYNCHRONOUS MACHINES Ph.D Thesis

Athanasios G Koronides 1980 171 p
Avail Univ Microfilms Order No 8112701

A computer model is developed to study the electromechanical interactions between superconducting generators and power systems during various fault conditions. A large set of equivalent circuits is used to represent the eddy currents on the finite length electromagnetic cylindrical shields which surround the superconducting field winding. The armature and field windings are represented by coupled circuits as in conventional generator models. The rotor turbine shaft dynamics are introduced in the model by a set of lumped masses representing the various stages of the turbine and the rotor, connected by springs representing the shaft. The electrical and mechanical equations of the machine are related by the air gap torque equation in a large system of simultaneous, nonlinear differential equations. The developed

computer algorithms used to study the transient behavior of a 300 MVA superconducting generator and the results are reported
Dissert Abstr

N81-27420# AEG-Telefunken Frankfurt am Main (West Germany) Forschungsinst

RELIABILITY STUDIES, CONSTRUCTION AND TEST OF A PILOT CABLE INSTALLATION WITH SUPERCONDUCTORS
Final Report

Hermann Franke Bonn Bundesministerium fuer Forschung und Technologie Nov 1980 228 p refs In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie Prepared in cooperation with Kabel u Metallwerke Gutehoffnungshuette AG and Linde AG (BMFT-FB-T-80-050 ISSN-0340-7608

BMFT-03E4036A/ETS0003A) Avail NTIS HC A11/MF A01

A high voltage superconducting flexible cable was developed and a demonstration cable segment was constructed Both the electrical insulation and the current carrying capacity of superconductors were investigated Relative to cryogenic design requirements thermal insulation was characterized as well as the contraction behavior of foils in a low temperature environment Results show that the line withstands the operating voltage (550 kV, 16 mA) while the cable terminals fail The cooling system for a larger cable installation is also described

Author (ESA)

N81-27422# Siemens A G Erlangen (West Germany) Research Lab

SUPERCONDUCTING ac CABLE Final Report

Fritz Schmidt Bonn Bundesministerium fuer Forschung und Technologie Nov 1980 353 p refs In GERMAN ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-80-074, ISSN-0340-7608) Avail NTIS HC A16/MF A01

The components of a superconducting 110 kV ac cable for power ratings ≥ 2000 MVA were developed The cable design is of the semiflexible type, with a rigid cryogenic envelope containing a flexible hollow coaxial cable core The cable core consists of spirally wound Nb-A1 composite wires electrically insulated by high pressure polyethylene tape wrappings A 35 m long single phase test cable with full load terminals rated at 110 kV and 10 kA was constructed and successfully tested The results obtained prove the technical feasibility and capability of this cable design

Author (ESA)

N81-27622*# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston, Tex

SATELLITE POWER SYSTEM CONCEPT DEVELOPMENT AND EVALUATION PROGRAM VOLUME 3 POWER TRANSMISSION AND RECEPTION TECHNICAL SUMMARY AND ASSESSMENT

R H Dietz G D Arndt J W Seyl L Leopold, and J S Kelley Jul 1981 280 p refs (NASA-RP-1076, S-507) Avail NTIS HC A13/MF A01 CSCL 10A

Efforts in the DOE/NASA concept development and evaluation program are discussed for the solar power satellite power transmission, and reception system A technical summary is provided together with a summary of system assessment activities System options and system definition drivers are described Major system assessment activities were in support of the reference system definition solid state system studies critical technology supporting investigations, and various system and subsystem tradeoffs These activities are described together with reference system updates and alternative concepts for each of the subsystem areas Conclusions reached as a result of the numerous analytical and experimental evaluations are presented Remaining issues for a possible follow-on program are identified

A R H

ENERGY STORAGE

Includes flywheels heat storage underground air storage
compressed air storage batteries, and electric hybrid vehicles

A81-30639 # Prolonged storage of jet fuels containing anti-oxidants (Dlitel'noe khranenie reaktivnykh topliv s antiokislitel'nymi prisdadkami) N I Melent'eva, I V Malysheva, and N N Kalitina *Khimiia i Tekhnologiya Topliv i Masel*, no 4, 1981, p 24, 25 In Russian

To investigate the possibility of extending the shelf life of the fuels T-6 and RT to five years and more, the fuels are studied over a 3-4 year period, both in the pure state and after the addition of antioxidants of alkyl phenol type. The samples, taken at the beginning of the storage period and after each year of storage, are analyzed using conventional methods and the method of accelerated oxidation. It is found that when the antioxidants are not used, the fuels may be stored for three years and more with no diminution of quality. Laboratory research shows that with the antioxidants, the period exceeds five years. C R

A81-36640 Latent heat storage J Schroder and K Gawron (Philips GmbH, Forschungslaboratorium, Aachen, West Germany) *International Journal of Energy Research*, vol 5, Apr-June 1981, p 103-109 21 refs

The investigations of materials presumably suitable as storage media for latent heat indicate that water, some salt hydrates and eutectic mixtures of water and salt hydrates possess extreme heats of fusion. Their melting points, ranging from about -50 to +130 C, fit well for storing low grade heat in residential energy systems. Detailed experimental investigations on a large number of these media show, however, that only a few of them satisfy the quality requirements for practical application in storage units. Flexible flat-plate storage containers especially developed for selected salt hydrates which expand on melting also show satisfactory performance over long periods of operation. In the case of water and selected water-salt hydrate eutectics the volume increases on solidification, and the expansion of solid storage material, being very inhomogeneous, breaks even flexible containers after only a few storage cycles. This ruinous local expansion can be avoided, however, by adding a small amount of special, lower melting salt hydrate eutectics which homogenize the crystallization and solidification of the storage medium. (Author)

A81-39136 * # Design and development of integral heat pipe/thermal energy storage devices E T Mahefkey (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) and R Richter (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1159* 7 p 6 refs USAF-sponsored research

The major design and performance test subtasks in the development of small (200 to 1,000 whr) integral heat pipe/thermal energy storage devices for use with thermally driven spacecraft cryo-coolers are described. The design of the integral heat pipe/thermal energy storage device was based on a quasi steady resistance heat transfer, lumped capacitance model. Design considerations for the heat pipe and thermal storage annuli are presented. The thermomechanical stress and insulation system design for the device are reviewed. Experimental correlations are described, as are the plans for the further development of the concept. (Author)

A81-40192 Solution redox couples for electrochemical energy storage I - Iron (III)-iron (II) complexes with o-phenanthroline and related ligands Y-W D Chen, K S V Santhanam, and A J Bard (Texas University, Austin, TX) *Electrochemical Society, Journal*, vol 128, July 1981, p 1460-1467 35 refs Contract No. DE-FC01-79ER-10000

Iron (III)-iron (II) complexes with o-phenanthroline and related ligands have been examined by electrochemical techniques in aqueous H₂SO₄ media with respect to their suitability as redox couples for electrochemical energy storage. The iron (II) complexes

undergo a rapid one electron oxidation at graphite and platinum electrodes to yield iron (III) complexes, these complexes showed varying stabilities depending on the nature of the substituents on the complexes. The iron (II) complexes examined in this study were formed with (1) monodentate, (2) bidentate, or (3) tridentate ligands. The redox couples have a higher formal potential value, which has been a positive consideration in the storage. Although the aquo-iron (II)-iron (III) couple has a formal potential value less than the complexes, it has shown greater promise in terms of storage stability. The kinetics of iron (II) complexation has been followed by cyclic voltammetry. (Author)

N81-22467*# Thermo Electron Corp Waltham Mass
**THERMAL ENERGY STORAGE FOR THE STIRLING ENGINE
POWERED AUTOMOBILE** Final Report
Dean T Morgan, ed Mar 1979 319 p refs Prepared for Argonne National Lab
(NASA Order C-2325 Contract W-31-109-38-4135)
(NASA-CR-159561 ANL-K78-4135-1 TE5484-66-79) Avail NTIS HC A14/MF A01 CSCL 10C

A thermal energy storage (TES) system developed for use with the Stirling engine as an automotive power system has gravimetric and volumetric storage densities which are competitive with electric battery storage systems, meets all operational requirements for a practical vehicle, and can be packaged in compact sized automobiles with minimum impact on passenger and freight volume. The TES/Stirling system is the only storage approach for direct use of combustion heat from fuel sources not suitable for direct transport and use on the vehicle. The particular concept described is also useful for a dual mode TES/liquid fuel system in which the TES (recharged from an external energy source) is used for short duration trips (approximately 10 miles or less) and liquid fuel carried on board the vehicle used for long duration trips. The dual mode approach offers the potential of 50 percent savings in the consumption of premium liquid fuels for automotive propulsion in the United States. A R H

N81-22468# Hittman Associates, Inc., Columbia, Md
**LIFE-CYCLE ENERGY ANALYSES OF ELECTRIC VEHICLE
STORAGE BATTERIES** Final Report
Daniel Sullivan, Terence Morse, Pragna Patel Subhash Patel Joseph Bondar and Larry Taylor Dec 1980 291 p refs
(Contract DE-AC02-79ET-25420)
(DOE/ET-25420/T1, H-1008/001-80-964) Avail NTIS HC A13/MF A01

Nickel-zinc, lead-acid, nickel-iron, zinc-chlorine, sodium-sulfur (glass electrolyte), sodium-sulfur (ceramic electrolyte), lithium-metal sulfide, and aluminum-air batteries were studied in order to evaluate the energy used to produce the raw materials and to manufacture the battery, the energy consumed by the battery during its operational life, and the energy that could be saved from the recycling of battery materials into new raw materials. The value of the life cycle analysis approach is that it includes the various penalties and credits associated with battery production and recycling which enables a more accurate determination of the system's ability to reduce the consumption of scarce fuels. Battery component materials, the energy requirements for battery production and credits for recycling are described. The operational energy for an electric vehicle and the procedures used to determine it are discussed. DOE

N81-22506# Massachusetts Inst of Tech, Cambridge
**PHOTOCHEMICAL ENERGY STORAGE: STUDIES OF
INORGANIC PHOTOASSISTANCE AGENTS** Progress
Report, 17 Dec. 1979 - 31 Mar 1981
Mark S Wrighton Dec 1980 31 p refs
(Contract DE-AS02-76ER-04178)
(DOE/ER-04178/4) Avail NTIS HC A03/MF A01

A number of small band gap p-type semiconductors were demonstrated to have poor H₂ evolution kinetics despite the fact that a reasonable output photovoltage (E sub V) compared to E sub g could be expected. Special emphasis was on p-type Si (E sub g = 1.1 eV). Both of these materials give poor kinetics for H₂ evolution from H₂O. A surface derivatizing reagent from diquaternizing 4,4 bipyridine with 1 bromo 3 trimethoxy-silylpropane can be used to functionalize p-type Si with polymeric quantities of redox reagent. DOE

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N81-22524# Hittman Associates Inc Columbia, Md
BATTERY RESOURCE ASSESSMENT SUBTASK 2.5
BATTERY MANUFACTURING CAPABILITY RECYCLING OF
BATTERY MATERIALS Final Report
 Paul Pemsler Feb 1981 40 p
 (Contract DE-AC02-80CH-10026)
 (DOE/CH-10026/T5 H-C2002/021-81-992-4) Avail NTIS
 HC A03/MF A01

Studies were conducted on the recycling of advanced battery system components for six different battery systems. These include nickel/zinc, nickel/iron, zinc/chlorine, zinc/bromine, sodium/sulfur, and lithium-aluminum/iron sulfide. For each battery system, one or more processes were developed which would permit recycling of the major or active materials. Each recycle process was designed to produce a product material which can be used directly as a raw material by the battery manufacturer. Metal recoverabilities are in the range of 93 to 95% for all processes. In each case, capital and operating costs were developed for a recycling plant which processes 100,000 electric vehicle batteries per year. DOE

N81-22546# General Electric Co Schenectady N Y Corporate Research and Development Dept
ALPHA-PLY LAMINATED-DISC FLYWHEEL ROTOR
 R P Nimmer 1980 9 p refs
 (Contract W-7405-eng-48)
 (UCRL-15307) Avail NTIS HC A02/MF A01

The composite flywheel is made up of a laminated S2-glass/epoxy disc and a filament wound graphite/epoxy outer ring. The two components are assembled with an interference fit and an aluminum hub is elastomerically bonded to the central disc. With this approach, both high energy density and high volume efficiency should be attainable. Two hybrid disc/ring flywheels were built and tested. As a part of the design process, extensive information was gathered with respect to failure modes, material properties, residual stresses, and dynamic characteristics. The improved design of these larger wheels should be reflected by energy densities in the vicinity of 60 to 66 Wh/kg (27 to 30 Wh/lb). DOE

N81-22555# AirResearch Mfg Co, Phoenix Ariz
RESIDENTIAL ENERGY STORAGE FLYWHEEL WITH A WIND TURBINE SUPPLY
 T W Place Apr 1981 103 p
 (Contract DE-AC04-76DP-00789)
 (SAND-79-7098 AirResearch-79-76189) Avail NTIS
 HC A06/MF A01

The conceptual design was developed for a minimum cost flywheel energy storage system which is suitable for mechanical interfacing with a wind-turbine energy source. The system has 10 kWh storage capacity and provides 5 kW peak power/output. Emphasis was placed on assuring that the system design is adaptable for upward-scaling to 50 kWh storage capacity and 10 kW peak power output. The system will provide 76 percent round trip efficiency and 1 percent/h maximum rundown loss. For production rates of 100,000 units per year, the estimated selling prices for the system in the 10 kWh and 50 kWh storage sizes are \$3581 (\$358/kWh) and \$9800 (\$196/kWh), respectively. DOE

N81-23205*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
INEXPENSIVE CROSS-LINKED POLYMERIC SEPARATORS MADE FROM WATER SOLUBLE POLYMERS
 Li-Chen Hsu and Dean W Sherbley 1979 16 p refs Presented at Ann Meeting of the Electrochem Soc Inc Los Angeles 14-19 Oct 1979
 (NASA-TM-82619, E-767) Avail NTIS HC A02/MF A01 CSCL 07D

Polyvinyl alcohol (PVA) crosslinked chemically with aldehyde reagents produces membranes which demonstrate oxidation resistance, dimensional stability, low ionic resistivity, low zincate diffusivity, and low zinc dendrite penetration rate which make them suitable for use as alkaline battery separators. They are intrinsically low in cost and environmental health and safety problems associated with commercial production appear minimal. Preparation, property measurements, and cell test results in Ni/Zn and Ag/Zn cells are described and discussed. Author

N81-23602*# Jet Propulsion Lab California Inst of Tech, Pasadena

ELECTRIC AND HYBRID VEHICLES CHARGE EFFICIENCY TESTS OF ESB EV-106 LEAD ACID BATTERIES
 John J Rowlette 15 Jan 1981 154 p
 (Contracts NAS7-100 DE-AI01-78CS-54209 JPL Proj 5030-462)
 (NASA-CR-164283 JPL-Pub-80-94 DOE/CS-54209/1) Avail NTIS HC A08/MF A01 CSCL 10C

Charge efficiencies were determined by measurements made under widely differing conditions of temperature, charge procedure, and battery age. The measurements were used to optimize charge procedures and to evaluate the concept of a modified coulometric state of charge indicator. Charge efficiency determinations were made by measuring gassing rates and oxygen fractions. A novel, positive displacement gas flow meter which proved to be both simple and highly accurate is described and illustrated. TM

N81-23608*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
RESPONSE OF NICKEL TO ZINC CELLS TO ELECTRIC VEHICLE CHOPPER DISCHARGE WAVEFORMS
 Robert L Cataldo 1981 10 p refs Presented at the Elec Vehicle Council Symp 6 Baltimore 21-23 May 1981 sponsored by the Elec Vehicle Council
 (Contract DE-AI01-77CS-51044)
 (NASA-TM-81713 DOE/NASA/51044-16, E-746) Avail NTIS HC A02/MF A01 CSCL 10C

The preliminary results of simulated electric vehicle chopper controlled discharge of a Nickel/Zinc battery shows delivered energy increases of 5 to 25 percent compared to constant current discharges of the same average current. The percentage increase was a function of chopper frequency, the ratio of peak to average current, and the magnitude of the discharge current. Because the chopper effects are of a complex nature, electric vehicle battery/speed controller interaction must be carefully considered in vehicle design to optimize battery performance. Author

N81-23653# Varta Batterie A G, Kelkheim (West Germany) Research and Development Center
DEVELOPMENT OF A LEAD-ACID BATTERY WITH HIGH ENERGY AND POWER DENSITY Final Report
 Karl-Ernst Baufeldt, Waldemar Borger, and Reinhard Braeutigam Bonn Bundesministerium fuer Forschung und Technologie Dec 1980 221 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-T-80-151) Avail NTIS (US Sales Only) HC A10/MF A01, DOE Depository Libraries

The energy density of lead acid cells was increased to more than 50 Wh5/kg by means of forced electrolyte flow through the active materials, and also by means of a construction method with a chequered electrode arrangement based on minimized electrolytic and electronic conduction paths and on optimized volume/surface area proportion. At the one hour discharge, the energy density is twice that of the MAN-bus cell. It is concluded that the energy density of the lead acid system can be increased to 60 Wh5/kg. The antimony-free effect causing the premature failure of cells in cycle tests can be explained on the basis of a model. The expander depot and a method of rejuvenating negative plates were developed. This procedure was successfully applied to a MAN-bus battery with reference to the battery periphery. Experience on a H2/O2 gas recombination device resulted in a hermetically sealed lead acid cell for electric vehicles. For the remote control of the state of charge, an indicator with automatic temperature compensation was developed. DOE

N81-23685# Los Alamos Scientific Lab N Mex
PRELIMINARY ASSESSMENT OF THE IMPACT OF FLYWHEEL ENERGY STORAGE TECHNOLOGY ON TAXICAB FLEET OPERATION IN A LARGE METROPOLITAN CITY
 Milton C Krupka and Sydney V Jackson Feb 1981 61 p refs
 (Contract W-7405-eng-36)
 (LA-8722-MS) Avail NTIS HC A04/MF A01

The incorporation of flywheel energy storage systems (FESS) into automotive vehicles for urban driving is discussed. A leveled life cycle cost comparison between a standard internal combustion engine vehicle (ICEV) in present use as a taxicab in New York City and a projected FESS/ICEV taxicab is generated. Potential energy savings and environmental benefits are discussed, and potential institutional barriers to FESS implementation are identified. The leveled life cycle cost comparison suggests that

FESS/ICEV costs are 33 percent/paid mile less than that of the ICEV the capital costs represent a small fraction of the total and are less than fuel costs in both categories. An assumed 50% increase in fuel economy (miles/gallon) translates to a 33.3 percent savings in fuel purchase for the same annual accumulated mileage by New York City licensed taxicabs. For approximately 12,000 vehicles at \$1.20/gallon, annual savings amount to approximately \$30.00 x 10(6) (approximately 25 x 10(6) gallons). Environmental improvement in the form of reduction emissions is expected with the introduction of FESS/ICEV taxicabs. DOE

N81-23697# Oak Ridge Y-12 Plant, Tenn. Fabrication Systems Dept.

ROCKWELL-ROCKETDYNE FLYWHEEL TEST RESULTS

R. S. Steele, Jr., E. F. Babelay, Jr., and B. J. Sutton. Jan. 1981. 49 p.

(Contract W-7405-eng-26)

(Y/DX-244) Avail. NTIS HC A03/MF A01

Results are presented of the spin test evaluation of the Rockwell-Rocketdyne RPE-10 design flywheel at the Oak Ridge Flywheel Evaluation Laboratory. Details of the static evaluation, including measures of weight, inertia, natural frequencies, and radiography, are also presented. The flywheel was subjected to seven spin cycles with a maximum of 383 rps. 105% of design speed. At that speed the energy stored was 1.94 kWhr at 36.1 Whr/kg. The maximum speed was limited by the inability of the test facility to accommodate the increasing eccentric shift of both hub disks with increasing speed. No material degradation was observed during the testing. DOE

N81-23706# Battelle Columbus Labs. Ohio. Electrochemical Technology Group.

ASSESSMENT OF NICKEL-HYDROGEN BATTERIES FOR TERRESTRIAL SOLAR APPLICATIONS. Final Report

John E. Clifford and Eric W. Brooman. Feb. 1981. 88 p. refs.

(Contract DE-AC04-76DP-00789)

(SAND-80-7191) Avail. NTIS HC A05/MF A01

The development of the nickel hydrogen (Ni-H₂) battery for aerospace applications was reviewed to determine the potential applicability to terrestrial photovoltaic energy storage. There are several desirable technical characteristics of Ni-H₂ cells that were demonstrated with aerospace cell designs that are of interest for terrestrial applications and photovoltaic energy storage in particular: long cycle life (> 7000 cycles) which was demonstrated for aerospace cells of high depth of discharge of 80% of rated (theoretical) capacity at high rate of charge and discharge; the potential for long calendar life with minimal maintenance requirements; pressure indication of state of charge and tolerance for overcharge, overdischarge, and operation at any state of charge. The relatively high rate of self discharge of aerospace Ni-H₂ batteries might be minimized for terrestrial, stationary storage applications where weight and volume are less critical. The principal disadvantage is the high cost associated with present aerospace designs of the Ni-H₂ battery. In view of the favorable technical performance, further study of the Ni-H₂ battery for terrestrial photovoltaic applications is recommended to determine the extent to which cost can be reduced without sacrificing performance. DOE

N81-23976# Ferschl (Michael S.), Milwaukee, Wis.

THE ELECTRIC MOPED

Michael S. Ferschl. 26 Feb. 1981. 37 p. ref.

(Contract DE-FG02-79R5-10157)

(DOE/R5-10157/2) Avail. NTIS HC A03/MF A01

Two electrically powered mopeds were designed and built. These vehicles offer single-person transportation which is convenient, quiet, low-cost, smooth, and pollution-free. The first moped has a 12 volt electrical system. The second has a 24 volt electrical system. They both have top speeds of about 20 miles per hour. They both use transistorized speed controls and deep-discharge, lead-acid batteries. These mopeds were put through a 750 mile test program. In this program, the 12 volt bike had an average range of nine miles. The 24 volt bike with a smaller battery capacity, had an average range of six miles. DOE

N81-23981# California Univ., Livermore. Lawrence Livermore Lab.

ADVANCED ELECTRIC VEHICLE

L. G. O'Connell. Jul. 1980. 20 p. refs.

(Contract W-7405-eng-48)

(UCRL-53089) Avail. NTIS HC A02/MF A01

The Advanced Electric Vehicle is defined as an automobile which can fulfill the general purpose role of today's internal combustion engine powered car without utilizing petroleum fuels directly. It relies principally on the utilization of electricity. A number of candidate systems are described. The present status of each is discussed as are the problems to be overcome before implementation can proceed. DOE

N81-24534*# National Aeronautics and Space Administration. Lewis Research Center. Cleveland, Ohio.

NASA PREPROTOTYPE REDOX STORAGE SYSTEM FOR A PHOTOVOLTAIC STAND-ALONE APPLICATION

Norman H. Hagedorn. 1981. 13 p. To be presented at the Intersociety Energy Conversion Eng. Conf., Atlanta, 9-14 Aug. 1981, sponsored by ASME.

(NASA-TM-82607, DOE/NASA/12726-8 E-854) Avail. NTIS HC A02/MF A01 CSCL 10C

A 1 kW preprototype redox storage system underwent characterization tests and was operated as the storage device for a 5 kW (peak) photovoltaic array. The system is described and performance data are presented. Loss mechanisms are discussed and simple design changes leading to significant increases in efficiency are suggested. The effects on system performance of nonequilibrium between the predominant species of complexed chromic ion in the negative electrode reactant solution are indicated. Author

N81-24536*# National Aeronautics and Space Administration. Lewis Research Center. Cleveland, Ohio.

LABORATORY EVALUATION OF A PILOT CELL BATTERY PROTECTION SYSTEM FOR PHOTOVOLTAIC APPLICATIONS

Robert L. Cataldo and Ralph D. Thomas. 1981. 14 p. refs. Proposed for presentation at the 16th Intersoc. Energy Conversion Eng. Conf. Atlanta, 9-14 Aug. 1981.

(Contract DE-AI01-79ET-20485)

(NASA-TM-81714, DOE/NASA/20485-7 E-747) Avail. NTIS HC A02/MF A01 CSCL 10C

An energy storage method for the 3.5 kW battery power system was investigated. The Pilot Cell Battery Protection System was tested for use in photovoltaic power systems and results show that this is a viable method of storage battery control. The method of limiting battery depth of discharge has the following advantages: (1) temperature sensitivity, (2) rate sensitivity, and (3) state of charge indication. The pilot cell concept is of interest in remote stand alone photovoltaic power systems. The battery can be protected from damaging overdischarge by using the proper ratio of pilot cell capacities to main battery capacity. EAK

N81-25168*# National Aeronautics and Space Administration. Lewis Research Center. Cleveland, Ohio.

SYNTHETIC BATTERY CYCLING

Lawrence H. Thaller. 1981. 13 p. refs. Proposed for presentation at the 16th Intersoc. Energy Conversion Eng. Conf. Atlanta, 9-14 Aug. 1981, sponsored by the American Society of Mechanical Engineering.

(NASA-TM-81757 E-820) Avail. NTIS HC A02/MF A01 CSCL 10C

The use of interactive computer graphics is suggested as an aid in battery system development. Mathematical representations of simplistic but fully representative functions of many electrochemical concepts of current practical interest will permit battery level charge and discharge phenomena to be analyzed in a qualitative manner prior to the assembly and testing of actual hardware. This technique is a useful addition to the variety of tools available to the battery system designer as he bridges the gap between interesting single cell life test data and reliable energy storage subsystems. EDK

N81-25170*# United Technologies Corp. South Windsor, Conn. Power Systems Div.

COST PROJECTIONS FOR REDOX ENERGY STORAGE SYSTEMS. Final Report, 30 Apr - 30 Sep 1979

Kenneth Michaels and Gene Hall. Feb. 1980. 97 p. refs.

(Contracts DEN3-126, DE-AI04-80AL-12726)

(NASA-CR-165260, DOE/NASA/0126-1 FRC-1784) Avail. NTIS HC A05/MF A01 CSCL 10C

07 ENERGY STORAGE

A preliminary design and system cost analysis was performed for the redox energy storage system. A conceptual design and cost estimate was prepared for each of two energy applications: (1) electric utility 100-MWh requirement (10-MW for ten hours) for energy storage for utility load leveling application and (2) a 500-kWh requirement (10 kW for 50 hours) for use with a variety of residential or commercial applications including stand alone solar photovoltaic systems. The conceptual designs were based on cell performance levels, system design parameters and special material costs. These data were combined with estimated thermodynamic and hydraulic analysis to provide preliminary system designs. Results indicate that the redox cell stack to be amenable to mass production techniques with a relatively low material cost. RCT

N81-25383# Teldix Luftfahrt-Ausruestungs G m b H, Heidelberg (West Germany)

THE INFLUENCE OF FIVE YEARS OF STORAGE ON THE OPERATIONAL READINESS OF A SATELLITE FLYWHEEL
D Repp / In ESA 2nd Space Tribology Workshop 1980 p 57-61
refs

Avail NTIS HC A08/MF A01

The influence of long term storage on TELDIX momentum wheels was investigated. The qualification model from the SYMPHONIE program was investigated after storage. All typical functional data were compared with the earlier qualification results to check any possible storage changes. After disassembling the momentum wheel all main parts were examined. Special investigations were performed on the ball bearing unit and its parts, on the motor and on the electronics. A small leak in a solder joint caused an internal pressure increase resulting in a 17% current consumption increase. No other changes in pre-storage qualification values are noted. Author (ESA)

N81-25513# Duracell International, Inc., Burlington, Mass
LITHIUM-THIONYL CHLORIDE BATTERY Final Report,
1 Oct 1978 - 30 Nov 1980

D Wong, W Bowden, N Hamilton, D Cubbison, and A N Day. Apr 1981. 290 p refs.
(Contract DAA807-78-C-0563, DA Proj 1L1-62705-AH-94)
(AD-A098727 DELET-TR-78-0563-F) Avail NTIS HC A13/MF A01 CSCL 10/3

The main objective is to develop, fabricate, test and deliver safe high rate lithium-thionyl chloride batteries for various US Army applications such as manpack radios and GLLD Laser Designators. We have devoted our efforts in the following major areas: (1) Optimization of the spirally wound D cell for high rate applications, (2) Development of a 3 inch diameter flat cylindrical cell for the GLLD laser designator application, and (3) Investigation of the reduction mechanism of SOCl₂. The rate capability of the spirally wound D cell previously developed by us has been optimized for both the manpack radio (BA5590) battery and GLLD laser designator battery application in this program. A flat cylindrical cell has also been developed for the GLLD laser designator application. It is 3 inches in diameter and 0.9 inch in height with extremely low internal cell impedance that minimizes cell heating and polarization on the GLLD load. Typical cell capacity was found to be 18.0-19.0 Ah with a few cells delivering up to about 21.0 Ah on the GLLD test load. Study of the reduction mechanism of SOCl₂ using electrochemical and spectroscopic techniques has also been carried out in this program which may be directly relevant to the intrinsic safety of the system. GRA

N81-25540# Sandia Labs, Livermore, Calif
MOLTEN NITRATE SALT TECHNOLOGY DEVELOPMENT
R W Carling, C M Kramer, R W Bradshaw, D A Nissen, S H Goods, R W Mar, J W Munford, M M Karnowsky, R N Biefeld, and N J Norem. Mar 1981. 102 p refs. Prepared in cooperation with Sandia National Labs., Albuquerque, N Mex (Contract DE-AC04-76DP-00789)
(SAND-80-8052) Avail NTIS HC A06/MF A01

Of the fluids proposed for heat transfer and energy storage, molten nitrate salts offer significant economic advantages. The nitrate salt of most interest is a binary mixture of NaNO₃ and KNO₃. Although nitrate/nitrite mixtures were used for decades as heat transfer and heat treatment fluids, the use was at temperatures of about 4500 C and lower. In solar thermal power systems the salts will experience a temperature range of 350 to 6000 C. Because central receiver applications place more rigorous demands and higher temperatures on nitrate salts, a comprehensive

experimental program was developed to examine what effects if any the new demands and temperatures have on the salts. The experiments include corrosion testing, environmental cracking of containment materials, and determinations of physical properties and decomposition mechanisms. DOE

N81-25550# Owens-Corning Fiberglas Corp, Granville, Ohio
Research and Development Div
COMPRESSION-MOLDED ENERGY-STORAGE FLYWHEELS
John F Kay. Oct 1980. 41 p refs.
(Contract W-7405-eng-48)
(UCRL-15324) Avail NTIS HC A03/MF A01

Structural sheet molding compound (SMC) consisting of chopped glass fiber reinforcement was used to fabricate energy storage flywheel discs which have the potential to store up to 25 W hr/lb (55 W hr/kg). The discs 21 in in dia and up to one inch thick were compression molded using E glass and S-2 glass reinforcement chopped to either one or two inches in length in a polyester matrix. In the molding of the one inch thick parts a proprietary Owens-Corning Fiberglas Corporation (OCF) molding process was used to preclude the formation of gross internal defects due to entrapped exotherm heat of reaction and nonisothermal curing conditions. DOE

N81-26375*# Sandia Labs, Albuquerque, N Mex
THE APPLICATION OF PERFLUOROCARBONS AS IMPREGNANTS FOR PLASTIC FILM CAPACITORS

G Howard Mauldin / In NASA Marshall Space Flight Center Capacitor Technol Appl and Reliability Jun 1981 p 13-17
refs. Sponsored in part by DOE

Avail NTIS HC A08/MF A01 CSCL 09A

A liquid impregnated plastic film (wet) capacitor was developed that is thought to be the most reliable and space efficient capacitor of any type ever produced for high voltage pulse discharge service. The initial design stores five times the energy of a premium quality dry capacitor of equivalent energy and reliability. The technology as well as a production capacitor design using this technology are described. RCT

N81-26378*# Sprague Electric Co., Clinton, Tenn
INFLUENCE OF CURRENT NEEDS ON THE ADVANCEMENT OF ALUMINUM ELECTROLYTIC CAPACITORS

Joseph A Moresi / In NASA Marshall Space Flight Center Capacitor Technol, Appl and Reliability Jun 1981 p 33-37

Avail NTIS HC A08/MF A01 CSCL 09A

The need for cost effective high performance long life capacitors with improved reliability is discussed. It is shown that a low cost miniature aluminum capacitor with improved reliability and proven life, can be produced with existing technology. It is further shown that the capacitor can be specified for 125 C life and shelf test requirements and meet established standards for their parametric performance. RCT.

N81-26986*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
EFFECT OF VOLTAGE ON THE COST OF AN ELECTRIC VEHICLE PROPULSION SYSTEM

Richard M Schuh and Edward F McBrien. 1981. 31 p refs.
Proposed for presentation at the 91st Natl Meeting of the Am Inst of Chem Engrs, Detroit, 16-19 Aug 1981.
(Contract DE-AI01-77CS-51044)
(NASA-TM-82592 DOE/NASA/51044-20 E-839)
Avail NTIS HC A03/MF A01 CSCL 13F

The life cycle cost and the purchase price of simple dc and ac propulsion systems are estimated as a function of battery voltage from 50 to 500 V. The results show a slight preference for a battery pack voltage of approximately 100 V. Three propulsion systems are examined: one has a series motor with a chopper controller, another an induction motor with an inverter controller, and the third a shunt motor using stepped-voltage control below base speed and field control above base speed. Motor power rating is assumed to be 20 kW continuous duty. The cost and the specific energy of a 24 kW-hr battery pack are estimated from 50 to 500 V by a battery manufacturer. The impact of system voltage variation on the efficiency, weight and cost of the other electrical components is estimated from basic electrical considerations and informal discussions with manufacturers. Author

N81-27529# Argonne National Lab Ill Energy and Environmental Systems Div

EVALUATION OF ADVANCED TURBOMACHINERY FOR UNDERGROUND PUMPED HYDROELECTRIC STORAGE PART 3 MULTISTAGE UNREGULATED PUMP/TURBINES FOR OPERATING HEADS OF 1000 TO 1500 m

A A Frigo and C Pistner (Allis-Chalmers Corp) Aug 1980 131 p refs

(Contract W-31-109 eng-38)

(ANL/ES-102-Pt-3) Avail NTIS HC A07/MF A01

Multistage unregulated pump/turbines for underground pumped hydroelectric storage are considered. Multistage unregulated pump/turbines offer an economically attractive option for heads of 1000 to 1500 m. The feasibility of developing such machines for capacities up to 500 MW and operating heads up to 1500 m has been evaluated. Preliminary designs have been generated for six multistage pump/turbines. The designs are for nominal capacities of 350 and 500 MW and for operating heads of 1000, 1250 and 1500 m. Mechanical, hydraulic, and economic analyses indicate that these machines will behave according to the criteria used to design them and that they can be built at a reasonable cost with no unsolvable problems. Efficiencies of 85.8 percent and 88.5 percent in the 1500 m unit. Performances of the other five machines are at least comparable and usually better. Over a 1000 to 1500 m head range, specific S/kW costs of the pump/turbines in mid 1978 US dollars vary from 19.0 to 23.1 for the 500 MW machines and from 1.0 to 24.1 for the 350 MW machines.

DOE

N81-27597# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

ADDITIVE FOR ZINC ELECTRODES Patent Application

D G Soltis, D W Sheibley and W J Nagle inventors (to NASA) Filed 10 Jun 1981 7 p

(NASA-Case-LEW-13286-1 US-Patent-Appl-SN-272406) Avail NTIS HC A02/MF A01 CSCL 10C

An improved zinc electrode for alkaline cells includes up to about ten percent by weight of Ba(OH)₂·8H₂O with about five percent being preferred. The zinc electrode may or may not be amalgamated with mercury.

NASA

N81-27633# MCC Associates Inc Silver Spring Md
PROCEEDINGS OF MECHANICAL MAGNETIC AND UNDERGROUND ENERGY STORAGE 1980 Annual Contractor's Review

1980 469 p refs. Proceedings held at Washington D C 10-13 Nov 1980. Prepared in cooperation with Battelle Pacific Northwest Labs.

(Contract DE-AC06-76RL-01830)

(CONF-801128) Avail NTIS HC A20/MF A01

Technologies in the development of renewable energy systems such as solar and wind energy are reviewed. Reliable, efficient and economic energy storage technologies are analyzed. The following topics are discussed: seasonal thermal energy storage, compressed air energy storage, magnetic energy storage, flywheel energy storage.

E A K

N81-27641# Energy Research Corp Danbury Conn
EVALUATION OF DISTRIBUTED GAS COOLING OF PRESSURIZED PAFC FOR UTILITY POWER GENERATION

Technical Progress Report, Aug - Nov 1980

J Ahmad, M Farooque, M Hooper and H Maru 1980 27 p

(Contract DE-AC01-78ET-13114)

(DOE/ET-13114/T6 TPR 4) Avail NTIS HC A03/MF A01

A proof of concept test of a gas cooled pressurized phosphoric acid fuel cell (PAFC) is provided. Significant progress includes design of subsystem components for the recirculation loop, fluid dynamic analyses of DIGAS cooling, and seal effectiveness testing of the baseline stack.

DOE

N81-27661# Battelle Columbus Labs Ohio
BATTERY STORAGE ON THE CUSTOMER SIDE OF THE METER ASSESSMENT Final Report

F J Bates, J E Clifford, M L Duchi, T R Martineau and J C Skelton 25 Feb 1981 365 p refs

(Contract W-7405-eng-92)

(BMT-2078) Avail NTIS HC A16/MF A01

An appropriate battery system for customer side and near

term demonstration and subsequent commercialization was chosen and evaluated in sufficient depth and clarity to form a solid technology base for the customer side regulatory institutional economic and market potential evaluation. The choice of batteries for a base system is lead-acid. Recognizing the potential near term availability of zinc-chloride batteries, a sensitivity analysis of battery system viability for this system was also conducted. A view of long term future customer side viability was prepared using DOE battery storage goals. Electric customer ownership, siting and operation of battery systems requiring the evaluation of many different issues from those relevant to utility ownership are discussed.

DOE

N81-27683# Varta Batterie AG Kelkheim (West Germany)
Forsch- und Entwicklungszentrum

DEVELOPMENT OF A LEAD ACID BATTERY WITH HIGH ENERGY AND POWER DENSITY Final Report

Karl-Ernst Baufeldt, Waldemar Borger and Reinhard Braeutigam. Bonn Bundesministerium fuer Forschung und Technologie Dec 1980 220 p refs. In GERMAN/ENGLISH summary. Sponsored by Bundesministerium fuer Forschung und Technologie.

(BMFT-FB-T-80-151 ISSN-0340-7608)

BMFT-03E4046A/ETS0001A) Avail NTIS HC A10/MF A01

The energy density of lead acid cells was increased to more than 50 Wh/kg for a 5 hr discharge. Improved design considerations included (1) forced electrolyte flow through the active materials and (2) a construction method with a checkered electrode arrangement based on minimized electrolytic and electronic conduction paths as well as optimized volume/surface area proportions. A method for rejuvenating negative plates was also studied. Hermetically sealed lead acid cells suitable for electric vehicle applications were constructed. Cycle life and performance tests show outstanding capacity (100 W/kg under heavy load i.e. 1 hr discharge) and a 1500 cycle problem free service life.

Author (ESA)

N81-27980# Jet Propulsion Lab California Inst of Tech Pasadena

VEHICLE TEST REPORT SOUTH COAST TECHNOLOGY ELECTRIC CONVERSION OF A VOLKSWAGEN RABBIT

T W Price, Thomas W Shain and James A Bryant 15 Feb 1981 181 p refs

(Contracts NAS7-100 DE-AIO1-78CS-54209)

(NASA-CR-164532 JPL-Pub-81-28)

Avail NTIS

HC A09/MF A01 CSCL 13F

The South Coast Technology Volkswagen Rabbit was tested at the Jet Propulsion Laboratory's (JPL) dynamometer facility and at JPL's Edwards Test Station (ETS). The tests were performed to characterize certain parameters of the South Coast Rabbit and to provide baseline data that will be used for the comparison of near term batteries that are to be incorporated into the vehicle. The vehicle tests were concentrated on the electrical drive system, i.e. the batteries, controller, and motor. The tests included coastdowns to characterize the road load, maximum effort acceleration and range evaluation for both cyclic and constant speed conditions. A qualitative evaluation of the vehicle was made by comparing its constant speed range performance with those vehicles described in the document state of the Art assessment of Electric and Hybrid Vehicles. The Rabbit performance was near to the best of the 1977 vehicles.

S F

N81-27985# Energy Research Corp Danbury Conn
RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report

Stanley Januszkiewicz, Hari Vaidyanathan, Mark Dodin and Tony Leo Mar 1981 243 p. Prepared for Argonne National Lab.

(Contract W-31-109-4248)

(ANL/OEPM-80-13, AR-3) Avail NTIS HC A11/MF A01

Progress in the development of nickel zinc batteries for electric vehicles is reported. Information is presented on nickel electrode preparation and testing, zinc electrode preparation with additives and test results, separator development and the evaluation of polymer blend separator films, sealed Ni-Zn cells and the optimization of electric vehicle type Ni-Zn cells.

DOE

N81-27986# Exide Management and Technology Co, Yardley, Pa

RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE

07 ENERGY STORAGE

PROPULSION Annual Report

Mar 1981 134 p Prepared for Argonne National Lab
(Contract W-31-109-38-4448)

(ANL/OEPM-80-15) Avail NTIS HC A07/MF A01

Battery design and development nickel cathode study and electrochemical studies are reported Battery design and development concentrated on the optimization of design parameters, including electrode spacing charging methods, modules and testing to verify these parameters Initial experiments indicated that an interelectrode spacing of 2.5 mm is optimum when normal (dc) charging is used Experiments on electrolyte concentration indicate that higher concentrations of KOH (8M 9M or 10M) are beneficial to capacity maintenance Available nickel cathodes were evaluated for possible use in the VIBROCEL These included pocket, sintered plaque impregnated nickel plated steel wool impregnated plastic bonded and CMG (multifoil) electrodes DOE

N81-27987# Gould, Inc Rolling Meadows, Ill

RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF NICKEL-ZINC BATTERIES FOR ELECTRIC VEHICLE PROPULSION Annual Report, 1 Sep 1979 - 30 Sep 1980

Mar 1981 98 p Prepared for Argonne National Lab

(Contract W-31-109-eng-38)

(ANL/OEPM-80-14 AR-3) Avail NTIS HC A05/MF A01

Progress in developing nickel zinc batteries for propelling electric vehicles is reported Information is included on component design battery fabrication and module performance testing DOE

N81-27989# AiResearch Mfg Co Los Angeles, Calif

NEAR-TERM ELECTRIC TEST VEHICLE ETV-2, PHASE 2 Final Report

Apr 1981 320 p refs

(Contract DE-AC03-76CS-51213)

(DOE/CE-51213/01) Avail NTIS HC A14/MF A01

A battery-powered passenger vehicle was developed that provides a significant improvement over conventional electric vehicle performance particularly during stop-and-go driving The vehicle is unique in two major respects: (1) the power system incorporates a flywheel that stores energy during regenerative braking and makes possible the acceleration capability needed to keep up with traffic without reducing range to unacceptable values and (2) lightweight plastic materials are used for the vehicle unibody to minimize weight and increase range These features were analyzed and demonstrated in an electric test vehicle ETV-2 Characteristics of this vehicle are summarized Information is presented on vehicle design fabrication, safety testing and performance testing power system design and operation flywheel battery pack performance and controls and electronic equipment DOE

08 GENERAL

A81-32276 ICC '80, International Conference on Communications, Seattle, Wash., June 8-12, 1980, Conference Record Volumes 1, 2, & 3 Conference sponsored by the Institute of Electrical and Electronics Engineers New York Institute of Electrical and Electronics Engineers, Inc., 1980 Vol 1, 473 p Vol 2 518 p, Vol 3, 362 p Price of three volumes, members, \$37.50 nonmembers, \$50

Topics discussed include switching systems and remote units, digital facility measurement techniques, coding for nonstationary or unknown channels, solar powered microwave radio, the impact of 1979 WARC on satellite system design, advanced communication satellite system concepts, the operation of guided optical systems, advanced communication system architecture, spread spectrum communications, and the encryption of analog signals. Attention is also given to voice and data communications in integrated digital networks, digital mobile radio, advanced communication spacecraft and earth station antennas, fiber optic transmission, picture coding, and the integrated design of communication earth stations. The effects of weather on satellite communication system design, adaptive techniques in telecommunications, remote sensing with electromagnetic waves, next generation satellite system design, digital modulation techniques, and applications of satellite onboard signal processing are also considered. **B J**

A81-34300 Materials for energy conservation and storage. **B C Tofield** (Atomic Energy Research Establishment, Materials Development Div., Harwell, Oxon, England) *Applied Energy*, vol 8, June 1981, p 89-142 108 refs

Selected aspects of materials research that may lead to the more efficient utilization of energy are reviewed. Following a brief discussion of the current and future states of materials and energy availability and usage, consideration is given to fuel cells for electricity generation, distributed electricity storage by electric vehicles, heat storage at generating plants by hot water, alternate temperature-change materials, or phase change materials, and hydrogen production using off-peak electricity. Possible future materials for use in heating and transportation are discussed, including coal derived gas and liquid fuels, sophisticated sensor systems for vehicular fuel flow control, batteries for electric vehicles and materials for combustion control by flue-gas monitoring and improved process monitoring. Underlying themes of many of the techniques discussed are noted to be the use of electrochemical processes, and the substitution of nonpremium for premium fuels. **S C S**

A81-34701 # Energy expenditures in cryogenic vacuum systems (K voprosu ob energozatratakh kriogennoi vakuumnoi sistemy) **Iu V Kholod, V F Lymar', and V B Iuferov** (Akademiia Nauk Ukrainnoi SSR, Fiziko-Tekhnicheskii Institut, Kharkov, Ukrainian SSR) *Voprosy Atomnoi Nauki i Tekhniki, Seriya Obshchaya i Iadernaya Fizika*, no 4, 1980, p 3-12 13 refs In Russian

The contribution of vacuum pumping energy expenditure (at 300 K) to the total energy expenditure of a cryogenic vacuum system is calculated. Calculations are compared with experimental data for a system consisting of a vacuum chamber of 800 liters, an internal cryopanel, and an external cryopump (with a pumping rate of about 540 liters/sec in the high-vacuum region). The divergence of theoretical calculations from experimental results does not exceed 20% for short operating times of the internal cryopanel and decreases with time. A condensation-adsorption cryopump has been fabricated and tested that pumps hydrogen, air, and nitrogen from atmospheric pressure to high vacuum with low consumption of the cooling agent (helium). **P T H**

A81-35998 Remote sensing for nuclear power plant siting. **B S Siegal** (Ebasco Services Inc., Greensboro, N C) and **C W Welby** (North Carolina State University, Raleigh, N C) (*American Society of Civil Engineers, Annual Convention and Exposition, Atlanta, Ga., Oct 22-26, 1979*) *ASCE, Transportation Engineering Journal*, vol 107, May 1981, p 317-329 5 refs

It is shown that satellite remote sensing provides timely and cost effective information for siting and site evaluation of nuclear power plants. Side looking airborne radar (SLAR) imagery is especially valuable in regions of prolonged cloud cover and haze, and provides additional assurance in siting and licensing. In addition, a wide range of enhancement techniques should be employed and different types of image should be color combined to provide structural and lithologic information. Coastal water circulation can also be studied through repetitive coverage and the inherently synoptic nature of imaging satellites. Among the issues discussed are snow cover, sun angle, and cloud cover, and actual site evaluation studies in the Bataan peninsula of the Philippines and Laguna Verde, California. **O C**

A81-37260 American Vacuum Society, National Symposium, 27th, Detroit, Mich., October 13-17, 1980, Proceedings Part I *Journal of Vacuum Science and Technology*, vol 18, Mar 1981 557 p

Topics discussed include nucleation related phenomena, sputtering and ion beam deposition, superconducting materials and devices, energy related thin films, surface electron structure, and the geometric structure of surfaces and adsorbates. Attention is also given to binary alloy surfaces, vibrational spectroscopy/magnetism, and surface oxidation of metals and semiconductors. Papers are presented on, among other topics, the influence of ion bombardment and intermediate layers on the adherence of gold to oxide substrates, on ion beam deposition of special film structures, and on laser annealing and epitaxy. **C R**

A81-37293 Critical data for critical needs. **D R Lide, Jr** (National Bureau of Standards, Office of Standard Reference Data, Washington, D C) *Science*, vol 212, June 19, 1981, p 1343-1349 42 refs

A review is presented of database requirements, which are anticipated to be of great importance in the near future for the solution of pressing energy, environmental and industrial productivity problems. Three major classes of data whose effective management must be achieved are identified: (1) repeatable measurements on well-defined systems, such as physical and chemical data, (2) observational data, including all measurements dependent on time or space which cannot be readily checked by remeasurement, as in atmospheric and geoscientific work, and (3) statistical data such as demographic trends, production and consumption records, etc. It is concluded that there must be coordination in the development of computer based systems, since duplication could greatly increase the already great costs of implementing on line systems. The process of this dissemination method's adoption will be made easier by the influx of younger engineers who have in the course of their education already been exposed to computer terminal use for data retrieval purposes. **O C**

A81-39105 # An evaluation of molybdenum and its alloys. **L B Lundberg** (California, University, Los Alamos, NM) *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1105* 10 p 39 refs

The choice of pure molybdenum as the prime candidate material for space reactor core heat pipes is critically examined. Pure molybdenum's high ductile-brittle transition temperature appears to be its major disadvantage. The candidate materials examined in detail for this application include low carbon arc-cast molybdenum, TZM molybdenum alloy, and molybdenum rhenium alloys. Published engineering properties are collected and compared, and it appears that Mo-Re alloys with 10-15% rhenium offer the best combination. Hardware is presently being made from electron beam melted Mo-13Re to test this conclusion. (Author)

N81-22091# California Univ., Livermore. Lawrence Livermore Lab. Metals and Ceramics Div. **ADVANCES IN MATERIALS SCIENCE, METALS AND CERAMICS DIVISION Triannual Progress Report, Jun - Sep 1980**

J J Truhan, ed. R W Hopper, ed., and K M Gordon, ed. 28 Oct 1980 37 p refs
Contract W-7405-eng-48

(UCRL-50058-80-3) Avail NTIS HC A03/MF A01

03-HYDROGEN

Information is presented concerning the magnetic fusion energy program, the laser fusion energy program, geothermal research, and nuclear waste management. Other topics include diffusion in silicate minerals, chemistry research resources, and chemistry and materials science research. **DOE**

N81-22497# Department of Energy, Washington D C Office of Field Operations Management
CAPSULE REVIEW OF THE DOE RESEARCH AND DEVELOPMENT AND FIELD FACILITIES

Sep 1980 53 p
(DOE/ER-0092) Avail NTIS HC A04/MF A01

Descriptions of DOE facilities are given for multiprogram laboratories (12) program dedicated facilities (biomedical and environmental facilities-12 fossil energy facilities-7, fusion energy facility-1, nuclear development facilities-3, physical research facilities-4, safeguards facility-1 and solar facilities-2), and production, testing and fabrication facilities (nuclear materials production facilities-5, weapon testing and fabrication complex-8). Lists are presented of DOE field and project offices, DOE field facilities by state or territory, names addresses, and telephone numbers, DOE R and D field facilities by type, contractor names and names of directors. **DOE**

N81-23294# Minnesota Univ, Minneapolis
CORROSION RESEARCH CENTER OF THE UNIVERSITY OF MINNESOTA Progress Report, 1 Jul - 31 Dec. 1980
R A Oriani 30 Jan 1981 178 p refs
(Contract DE-AC02-79ER-10450)
(DOE/ER-10450/1) Avail NTIS HC A08/MF A01

At present the research ranges from the quantum mechanics of the corrosion unit reactions, organic and inorganic coatings surface reactions on polymers metals and semiconductors to high temperature chemistry of interest to solar energy conversion. A second objective of the Center is to increase the utilization of corrosion data by the technical community through education and through the dissemination of appropriately formatted information. At present, two projects are in the planning stage for the near future. One is a pedagogical symposium on corrosion in microelectronic components and systems, the other is a series of lectures and videotapes as well as a workshop on cathodic protection. **DOE**

N81-23327# Army Cold Regions Research and Engineering Lab, Hanover N H
BUILDING UNDER COLD CLIMATES AND ON PERMAFROST COLLECTION OF PAPERS FROM A US-SOVIET JOINT SEMINAR

Dec 1980 381 p refs Conf held at Leningrad, USSR Jun 1979
(Contract HUD-IA-655)
(AD-A097516 CRREL-SR-80-40) Avail NTIS
HC A17/MF A01 CSCL 13/13

The building of homes and other structures in cold weather poses special design and logistical problems for architects urban planners, and construction engineers. As the United States expands development in the Arctic and Subarctic regions of North America access to the research and achievements of other nations experienced in cold weather construction becomes increasingly important. The Soviet Union with so much of its vast territory lying in the far north performs about 85 percent of the world's research in this field. For this reason experts at the U S Army Corps of Engineers have actively cooperated with Soviet experts under the framework of the U S-U S S R Agreement on Cooperation in the Field of Housing and Other Construction. The articles in this collection have been classified into the following five sections: Aspects of Architectural Planning, Construction and Environmental Considerations, Principles of Foundation Design and Behavior, Foundation Stabilization, Concrete Construction and Excavation Techniques. **GRA**

N81-24565# Sandia Labs Albuquerque, N Mex Fluid Mechanics and Heat Transfer Div
SOLTES. SIMULATOR OF LARGE THERMAL ENERGY SYSTEMS

Merton E Fewell and Norman R Grandjean 1981 11 p refs
Presented at the 3rd Ann Systems Simulation, Econ Anal Solar Heating and Cooling Operational Results Conf Reno Nev, 27 Apr 1981
(Contract DE-AC04-76DP-00789)

(SAND-80-1578C CONF-810405-9) Avail NTIS
HC A02/MF A01

The philosophy structure, current capability and applications of SOLTES a computer code that can be used to simulate a wide variety of thermal energy systems such as solar power/total energy fossil-fired power plants/total energy nuclear-fired power plants/total energy solar energy heating and cooling geothermal energy and solar hot water, are discussed. The SOLTES program simulates the steady-state response of thermal energy systems to time-varying data such as weather and loads. **DOE**

N81-25202# Iowa State Univ of Science and Technology, Ames Dept of Materials Science and Engineering
CREEP OF MONOLITHIC REFRACTORY MATERIALS Final Report

Thomas D McGee, Jay R Smyth, and Donald J Bray Nov 1980 50 p
(Contract DE-AS05-78OR-13402 EPRI Proj 1481)
(DOE/OR-13405/T1. ISU-ERI-AMES-81402) Avail NTIS
HC A03/MF A01

The objective was to evaluate the creep behavior of refractory materials used in the linings of coal gasification process vessels. The work is subdivided into nine tasks: literature review, equipment and materials selection, specimen preparation, short term creep measurements, analysis of test specimens stress relaxation measurements, long term creep measurements, data correlation, and consultation. Materials tested were Al₂O₃ generic refractory and neat concretes calcium-aluminate cements and aggregates. **DOE**

N81-25504*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
ENERGY AN ANNOTATED SELECTED BIBLIOGRAPHY
Sandra J Blow, comp, Richard W Peacock, comp, and Joseph J Sholy, comp Dec 1979 599 p 2 Vol
(NASA-TM-82364, BIB-74-01-App-3-Vol-1) Avail NTIS
HC A99/MF A01 CSCL 10A

This updated bibliography contains approximately 7,000 selected references on energy and energy related topics from bibliographic and other data sources from June 1977. Under each subject heading the entries are arranged by the date, with the latest works first. Subject headings include resources supply/demand and forecasting policy, legislation, and regulation, environment, consumption, conservation, and economics, analysis systems and modeling and information sources and documentation. Fossil fuels, hydrogen and other fuels, liquid/solid wastes and biomass waste heat utilization, and nuclear power sources are also included. **J M S**

N81-25505*# National Aeronautics and Space Administration Langley Research Center Hampton, Va
ENERGY AN ANNOTATED SELECTED BIBLIOGRAPHY
Sandra J Blow comp, Richard W Peacock, comp, and Joseph J Sholy comp Dec 1979 739 p 2 Vol
(NASA-TM-82365, BIB-74-01-App-3-Vol-2) Avail NTIS
HC A99/MF A01 CSCL 10A

This updated bibliography contains approximately 7,000 selected references on energy and energy related topics from bibliographic and other data sources from June 1977. Under each subject heading the entries are arranged by the date, with the latest works first. Geothermal solar, wind, and ocean/water power sources are included. Magnetohydrodynamics and electrohydrodynamics, electric power engineering, automotive power plants and energy storage are also covered. **J M S**

N81-25575# Applied Physics Lab Johns Hopkins Univ Laurel, Md Applied Physics Lab
ENERGY PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Jul - Sep 1980.
K Yu R vonBriesen, J E Tillman, F C Paddison, and S Kane Nov 1980 39 p ref
(Contracts DE-AI01-79ET-27025, EX-76-A-38-1008)
(PB81-151615, JHU/APL/EQR/80-3) Avail NTIS
HC A05/MF A01 CSCL 10A

The programs are divided into four major areas of research. The Geothermal Energy Development Planning and Technical Assistance section reports on progress of geothermal related tasks. The Operational Research and Hydroelectric Power Development section includes small scale investigations in the

southeastern states The Seismotectonic Investigations section describes neotectonic investigations of the Manhattan Prong The Energy Conversion and Storage Techniques section contains an evaluation of the Einstein refrigerator OTEC pilot plant performance calculations, and a study of landfill methane recovery

T M

N81-25587# TRW Inc Redondo Beach Calif
SCRUBBER-GENERATED PARTICULATE LITERATURE SURVEY Final Report

R F Maddalone, B Jackson and C Yu Mar 1981 126 p
 refs Sponsored by Electric Power Research Inst
 (EPRI Proj 982-11)
 (EPRI-CS-1739) Avail NTIS HC A07/MF A01

The growth of flue gas desulfurization (FGD) systems to remove SO₂ and particulate matter raises concern over the potential emissions from the FGD system The most prevalent type of FGD system is wet scrubbers that use a variety of alkaline solutions and gas contact schemes to remove the O₂ from the flue gas The present state of knowledge about scrubber generated particulate (SGP) was assessed with emphasis on sampling and analysis methods for SGP mist eliminator entrainment and particle penetration Computer searches were supplemented by a manual review of selected documents and by telephone contacts to key individuals Most of the available literature consists of studies on penetration by particle size and mist eliminator design and efficiency Only a few cases of direct information on SGP were found The information suggests that SGP may represent 10 to 50 percent of the particulate emitted from an FGD system however better sampling and analysis methods are needed to provide a definitive estimate of SGP

DOE

N81-26293# Army Construction Engineering Research Lab,
 Champaign, Ill

BUILDING LOADS ANALYSIS AND SYSTEM THERMODYNAMICS (BLAST) PROGRAM USERS MANUAL VOLUME 1 SUPPLEMENT (VERSION 3.0) Final Report
 Dale Herron, George Walton and Linda Lawrie Mar 1981
 119 p refs Supplement to CERL-TR-E-153-Vol-1 and CERL-TR-E-153-Vol-2

(Contracts MIPR-FY7615-79-05134 DE-A101-79CS-30301)
 (AD-A099054, CERL-TR-E-171-Vol-1-Suppl) Avail NTIS
 HC A06/MF A01 CSCL 09/2

BLAST Version 3.0 can be used to model passive solar applications and to analyze large-scale industrial facilities Parameters, users can study with BLAST Version 3.0 (in addition to BLAST 2.0 capabilities) include (1) interzone heat transfer and ventilation, (2) movable insulation, (3) daylighting, (4) exact internal solar distribution, (5) radiant temperature control, (6) exterior radiant interchange, (7) mechanical ventilation, (8) process heat as heat source (9) latent air-to-air heat recovery, (10) water-cooled packaged systems, (11) induction unit systems, (12) direct-drive chillers, and (13) purchased steam from utilities BLAST version 3.0 also offers the user a generalized report writer and several new output report options not available from BLAST Version 2.0 Although the simulation capabilities of BLAST Version 3.0 are expanded over BLAST Version 2.0, users familiar with BLAST Version 2.0 can use Version 3.0 without modifying their approach or their BLAST input

GRA

N81-26566# Technical Information Center Oak Ridge, Tenn
 Technical Information Center

APPROPRIATE TECHNOLOGY: A BIBLIOGRAPHY

L M Thompson, ed Mar 1981 56 p
 (DOE/TIC-3385) Avail NTIS HC A04/MF A01

This bibliography of 191 citations and abstracts contains the entries on the subject that appear in the DOE Energy Data Base as of February 28, 1981 The citations are arranged by subject category, with each category first ordered alphabetically by report number followed by an inverse chronological order for books, monographs, and journals Corporate, author, subject, contract number, and report number indexes follow the abstracts

DOE

N81-28036# National Aeronautics and Space Administration
 Marshall Space Flight Center, Huntsville, Ala
FY 1980 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS
 O L White comp Oct 1980 67 p

(NASA-TM-78313) Avail NTIS HC A04/MF A01 CSCL 05B

Abstracts are presented for 60 technical memoranda and 5 technical papers published in technical journals or presented by MSFC personnel in FY 1980 Conference and reference publications are cited along with contractor reports and papers cleared for presentation

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